IN THIS ISSUE:

THE ROMANCE OF TUNGSTEN
WHO INVENTED IT FIRST?

SCIENTIFIC AMERICAN

A Weekly Review of Progress in

INDUSTRY · SCIENCE · INVENTION · MECHANICS

LANDING AND SCALING LOGS NEAR THE LARGE MAINE FORESTS.—[See page 122]

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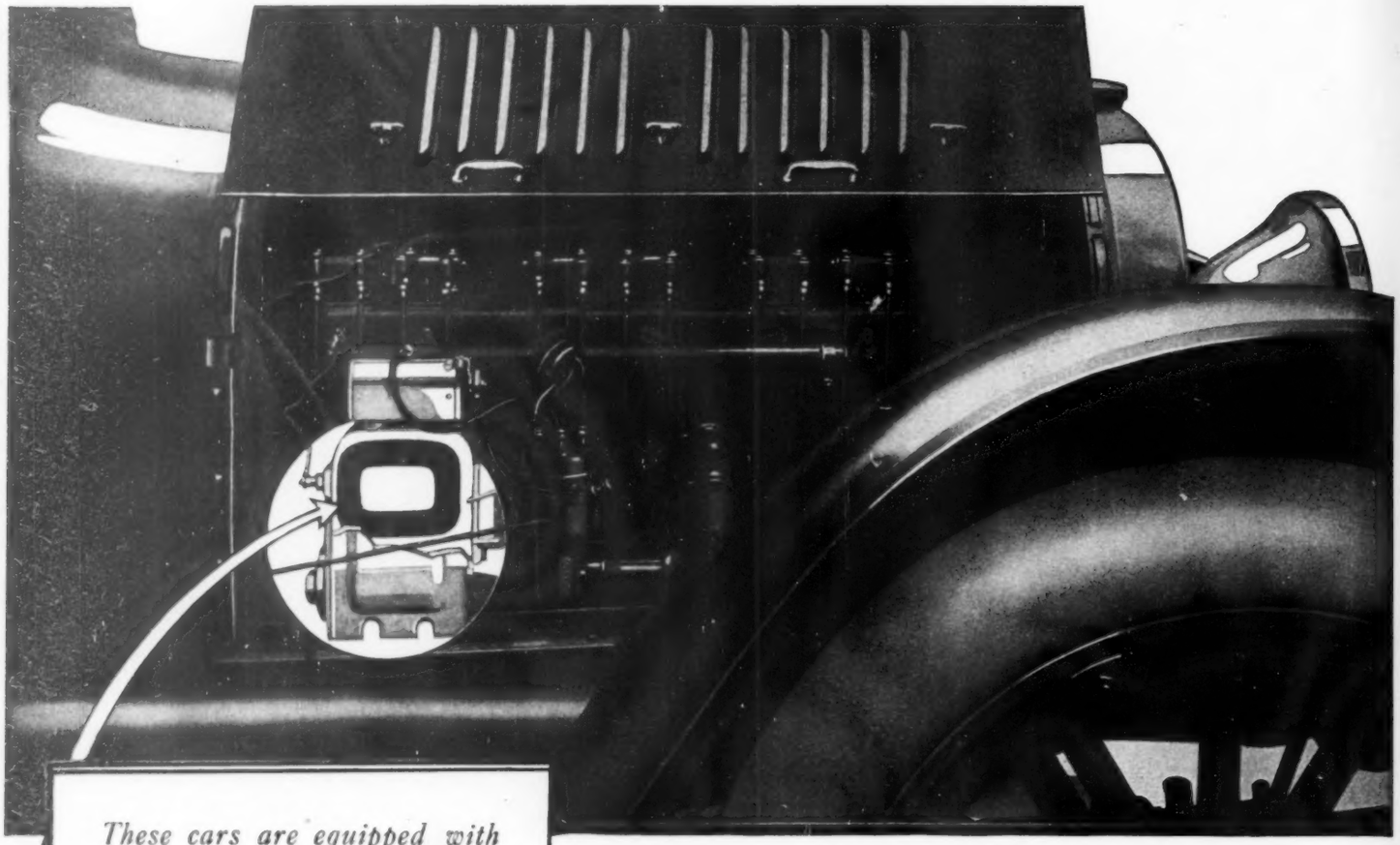

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Chevrolet	Overland
Cole	Packard
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Jordan	Reo
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SEVENTY-SIXTH YEAR

SCIENTIFIC AMERICAN

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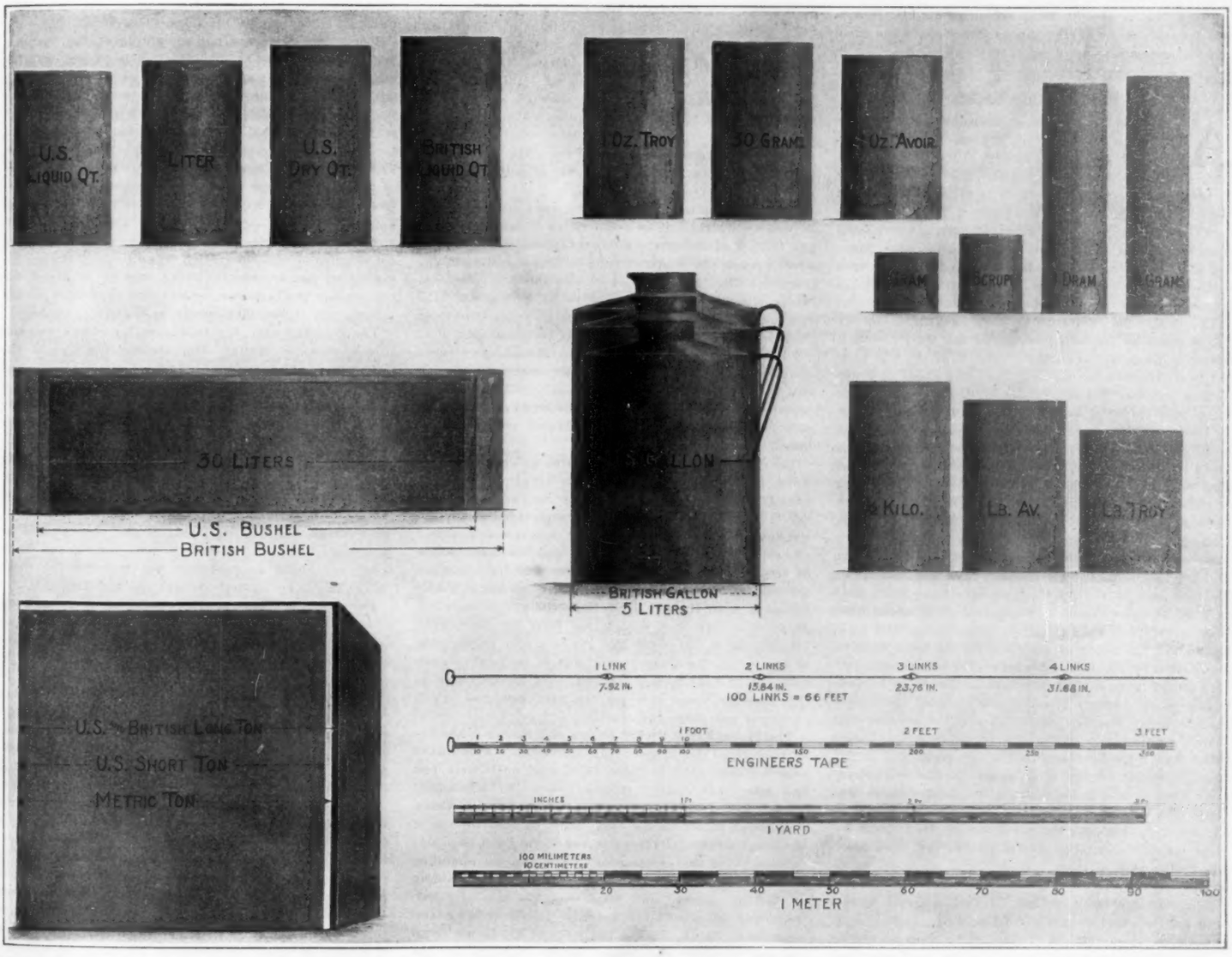

Legal equivalents and ratios of the units and measures which appear in the above diagram

MEASURES OF CAPACITY				
U. S. liquid quart	57.75	cubic inches or	946.33	milliliters
Liter	61.025	"	1,000.	"
U. S. dry quart	67.201	"	1,101.198	"
Imperial quart	69.366	"	1,136.	"
U. S. bushel	2,150.42	"	35,238.3	"
Imperial bushel	2,219.7	"	36,367.7	"
U. S. gallon	231.	"	3,785.332	"
Imperial gallon	277.463	"	4,545.963	"

A milliliter for all but the most precise work is identical with one cubic centimeter (1.000027 cc.).

MEASURES OF LENGTH				
	Inches or	Feet or	Centimeters or	Meters
Link	7.92	.66	20.117	.2012
Chain	792.	66.	2,011.684	20.117
Foot	12.	1.	30.48	.305
Yard	36.	3.	91.44	.914
Meter	39.37	3.281	100.	1.

MEASURES OF WEIGHT				
Ounce avoirdupois	437.5	grains or	28.35	grams
Ounce Troy	480.	"	31.103	"
Gram	15.432	"	1.	"
Scruple	20.	"	1.296	"
Dram	60.	"	3.888	"
Kilogram	15,432.356	"	1,000.	"
Pound avoirdupois	7,000.	"	453.592	"
Pound Troy	5,760.	"	373.242	"
Long ton	2,240.	pounds	1,016.047	kilograms
Metric ton	2,204.62	"	1,000.	"
Short ton	2,000.	"	907.185	"

COMMON WEIGHTS AND MEASURES USED IN AMERICA AND THE BRITISH EMPIRE, BASED ON THE SAME SERVICES AND HAVING THE SAME NAMES—(See page 125)

SCIENTIFIC AMERICAN

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

Fair Weather Yachts

ALTHOUGH the failure of "Resolute" and "Shamrock" to race in a 22-knot breeze and a tumbling sea on Saturday, July 24th, was a keen disappointment to yachtsmen who were rejoicing in the prospect of a battle royal to windward between the Cup yachts, the incident cannot fail to have a beneficial effect upon the future of such international contests; for it has served to emphasize once more the fact that scantling has been reduced and sail area increased to such a degree that the boats built to compete for the Cup are no longer seaworthy.

The conditions on Saturday were such as to justify the skippers of the two yachts and the Race Committee in calling off the contest. The wind, by the time the boats reached the starting line, was about 22 knots with a possible 28 knots in the puffs; but it was the steep and confused sea that constituted the danger. In broad reaching from Sandy Hook to the Lightship, both boats labored heavily, and the moment they came up in the wind, it was seen that the seas were so short that in a thrash to the outer mark, these fast moving boats would be heavily punished. Furthermore, they have no bulwarks and have nothing more than small, longitudinal cleats on which the crew can find a footing. The seas would have swept the boats fore and aft, and even if hull framing had held and masts had not gone by the board, it is more than likely that in a fifteen-mile thrash to windward, men would have been swept from the decks.

And yet the day was one that would have rejoiced the hearts of the men who sailed the sloops and cutters of thirty to forty years ago on this same historic Sandy Hook course. There comes to mind the classic race between "Puritan" and "Genesta," when the wind blew twenty knots at the start, and "Puritan" sent down her topmast and "Genesta" substituted a jib-headed topsail for her club topsail in the fifteen-mile beat back to the finish. Says the chronicler of that time, Mr. Winfield Thompson, "The wind was now squally . . . both yachts were sailing with their lee rails under water, their decks awash, the wind blowing at the rate of nearly thirty knots an hour, which caused an ugly sea."

The moral of this incident is that America should join all the other countries of the world in the adoption of the rule which is producing fast and seaworthy yachts that are serviceable alike both for racing and cruising. Unless a rule specifies a limit of lightness beyond which the designer must not go in any given class, clever designers, such as Herreshoff and Nicholson, will always find a way to build extremely fast and over-light boats, and yet keep within the rule. Under such a rule that staunch and very beautiful yacht, the 23-meter "Shamrock" was built. This craft has full cruising accommodations, is extremely staunch in construction, and has a turn of speed sufficient to satisfy the most exacting demands of the racing enthusiasts. She would have revelled in the weather conditions of Saturday. Our own rule produces a wholesome boat as regards form and sailspread, but it fails to set a limit upon light construction, and the result was seen on Saturday when "Resolute," in common with "Shamrock," was unwilling to face the music. It is for us, in common with the yachting nations of all the world, to set a ban upon freak construction, and build to a universally adopted rule which will enable our yachts to compete with yachts anywhere in the world, under similar conditions, at whatever port she may call.

Wood as a Structural Material

SHORTLY before the war one of our leading bridge engineers made the statement that, in view of the enormous consumption of steel and the multiplying rate at which it was proceeding, the time would come when we should be threatened with a shortage of this material. Among the comparatively modern constructions which have made a heavy inroad upon our supplies of iron ore, he mentioned the towering office, hotel and apartment buildings, which, before the war, were being built by the thousand throughout the country. The enormous expansion in our industries has created a proportionate demand for structural steel; and although the growing use of concrete has served to lessen the demand, the steel reenforcement foots up a heavy annual total. Although the building trades are passing through a period of stagnation, the reduced consumption of steel, due to this, is temporary and it will be more than counterbalanced by the tremendous demand that will ensue when normal conditions return, and we attempt to make good the arrears of construction.

As for the railroads, the largest part of the billions of dollars which will be required as a consequence of the neglect of the past half dozen years will be spent upon steel in the shape of rails and steel rolling stock. Moreover the great revival in our merchant marine, which we all hope will prove to be permanent, will call for heavy deliveries of shapes and ship plates—a demand which before the war was insignificant.

All of which suggests the wisdom of casting our eyes about in search of substitutes for steel, which can compete with it in cost and durability; and the first material that comes to mind is the wood of which we still have such a potential store in our sadly depleted but still magnificent forests.

Leaving out of consideration the extensive use of wood for home building, we are apt to forget how greatly we were indebted, in the earlier decades of our industrial progress, to our timber supplies for the construction of our factories, the marvelous post-war extension of our railroad system, and the construction of the famous clipper ships of our merchant marine. As regards the construction of our transcontinental railroads with their many ramifications, it is no exaggeration to say that, had it not been for the superb Douglas fir of the West and the long-leaf yellow pine of the South, the pioneer railroads of the last century could never have been pushed out over the continent at the amazing speed and for the very low cost which characterized their construction.

The Howe Truss timber bridge and timber viaduct—without these our pioneer railroad builders would have been helpless. For in those days, steel mills were few and steel was costly; whereas, once the Mississippi Valley was crossed the engineer found himself within easy reach if not in the very midst of vast forests of the finest structural timber in the world. All that was necessary for the crossing of rivers and the spanning of deep ravines was to erect a sawmill in the adjoining or nearby forest, and send east a bill of steel, consisting of screwbolts for his timber trestles and round bars for the tension members of his Howe Truss bridges, together with some simple castings for the footing of the compression members.

But all that was long, long ago; whereas our object is to suggest that there are many forms of construction in which we might turn once more to wood and get excellent results. Nor should the deplorable outcome of our recent attempt to build a fleet of wooden ships be allowed to shut the door upon wooden shipbuilding. Timber that was standing in the forest one month was framed into a ship the next—and ships that were built of green wood had only one fate in store for them.

But it is far from proved that there is no place for the wooden ship on the high seas. Yacht Designer Nicholson, who has produced a staunch and tight boat in "Shamrock," believes that the multi-ply system can be used on ocean-going ships, and that by sawing the timber into planks for "ply" construction, the wood can be so rapidly seasoned as to make it possible to reduce the time between the felling of the timber and its incorporation in the hull to a practicable limit.

As to the durability of timber, there are county wooden bridges doing good service, even today, that must have seen a good "three score years and ten" of service in the open, and there are timber roofs above the vaulted masonry roofs of European cathedrals that have stood untouched and perfectly sound for centuries.

Re-Stocking Our National Resources

OUR national life these days seems to be little more than one worry after another. One day we hear that gasoline will soon be unknown; the next day we read that farmers are raising insufficient food and that we face an early famine; another day it is a coal shortage that stares us in the face; comes another day and it is our disappearing forests. Calamity threatens on all sides, to be sure.

These conditions are not something of the moment. We are always too ready to blame the recent war for our latest worries; and the shortage in production and our depleted resources are almost invariably charged up to our late military efforts. Yet the truth of the entire matter is that the world has long been living in the present, with little or no thought for the future. Thus forests have been cut down without consideration of the morrow; new ways and means of consuming petroleum products have developed without end; warehouses have been drained of their accumulated foodstuffs; coal reserves have been taken while waiting for improved transportation conditions. It is this matter of hand-to-mouth living that is to blame for our present predicament; and in this particular we are perhaps the worst offenders to be found anywhere.

The time has come for an accounting—for a national inventory so to speak. The various Bureaus of the Government, the leading industrial associations, and the large manufacturing organizations have taken a share in this inventory. For the first time these parties are seriously and exhaustively going through the cupboards of the nation in order to determine just what stocks we still can count upon in the form of natural resources. And the facts and figures of this nation-wide inventory are being passed on to the man in the street since he, as the ultimate consumer, must know why things are not as plentiful and inexpensive as they used to be. Furthermore, said man in the street must be taught to moderate his appetite for those things which he formerly considered inexhaustible.

For example: Our most pressing conservation question relates to our forests. Out of 850 million acres of virgin timber we have but 150 million left. We have effectually exhausted the timber lands of the Northeast and of the once magnificent forest States of Pennsylvania, Wisconsin and Minnesota. About ten years will see the Southeast, which has been our greatest producer of saw timber for years, out of the running as a serious competitor in the lumber markets. Already much of the timber for the thickly populated East and Middle West comes from beyond the Rockies.

Facts such as these are interesting, vitally interesting. They should receive wide circulation among thinking men. Such knowledge leads to a better understanding of present industrial conditions, and in a great measure must hasten and perfect the various phases of our gigantic re-stocking scheme which alone can ward off the several calamities with which we are threatened. The SCIENTIFIC AMERICAN has always made it a point to study all questions having to do with the welfare of these United States. Its editors have long foreseen the advent of this day when a nation-wide inventory would confront the people with cold, harsh facts about depleted resources and the urgent need of immediate conservation and replenishment.

Elsewhere in this issue there is a story of what takes place in the wake of the woodsman. It is a depressing story. It tells of the man-made deserts to be found in this country, where formerly there flourished the finest forests to be found anywhere. It tells of man-made floods which must now be combated with elaborate and costly dams. But it is a story that must be told if we are to avoid the mistakes of yesterday and to re-stock the nation's shelves.

Electricity

To Make Wood Acid Proof.—Some storage batteries are carried in wooden battery boxes on cars and annoy the owners by leaking or slopping of the acid. To make the wood acid proof take six parts of wood tar and 12 parts resin, and melt them together in an iron kettle, after which stir in eight parts of finely powdered brick dust. The surface to be covered must be thoroughly cleaned and dried before painting with the warm preparation.

Non-Leaking Storage Battery.—A new storage battery said to be absolutely non-leaking has been produced. It has a special valve to let off the explosive gas, so arranged that no acid can get out. The plates are separated by strips of wood which not only prevent short-circuiting inside the cell, but retain the acid when the storage battery is upside down, giving an electrical efficiency of 75 per cent in this position. This battery is a German invention.

Cable Construction.—Despite the great development of wireless telegraphy, submarine cables are still being constructed, and with the great increase in commercial and journalistic messages are still regarded as a necessary alternative to wireless, and by no means obsolete or likely to fall into disuse. In fact, a new cable to the Far East from Great Britain through the Mediterranean, involving a length of 7,000 miles, is being laid section by section as ready, while the possibility of a new cable from Vancouver to Fanning Island is now being discussed.

Electric Signals for Guiding Ships.—In a recent French periodical there appears a description of a French method for guiding ships in foggy weather through narrow channels, harbors and so on. The method consists essentially in feeding with alternating current submarine cables or cables laid in the air along the piers and in observing on board ship the positions of said cables by the aid of frames connected to telephones. The frame can be rotated around an axis parallel to the fore-and-aft line of the ship, so that it can be ascertained if the cable is "starboard" or "port" of the ship.

Hydro-Electric Development in Ceylon.—It is reported that Ceylon has again taken up the work of investigating its widespread hydroelectric resources, which work was delayed by the war, and it is expected arrangements will proceed rapidly for the early initiation of the proposed electrification of the island's industries and the partial transformation of the transportation systems from steam to electricity, including the extension and development of the use of electricity for domestic purposes in Colombo and other centers of population. Although the standard American frequency of 60 cycles has been prevalently employed in eastern countries during recent years, the electrical adviser to the Government of India, who was lent to the Government of Ceylon to study the above projects, strongly recommends the British standard of 50 cycles, and states in his report that it is confidently anticipated that the consulting engineers employed to draw up the specifications will be able to place the order for the equipment within the British Empire.

Suspension Insulators.—Notwithstanding the recent improvements in porcelain insulators, failures are sufficiently common so that allowance must be made for them. A certain factor of safety is required, in the shape of extra insulation, to provide for the electrical unreliability of the insulators themselves apart from conditions of abnormal operating stresses. There are a wide variety of operating conditions which affect the amount of over-insulation required, and after having found the minimum number of insulators per string required for any given operating condition, Mr. A. M. Klamber, in a paper read before the American Institute of Electrical Engineers, points out a method of determining the amount of extra insulation desirable from an insurance standpoint according to the law of probabilities. Equations are developed from which the probability of failure for any given case or the ratio between such probabilities for any pair of cases may be determined directly. A numerical example is also given which shows the development of the theory of minimum annual cost for combined mechanical and electrical failures.

Science

An Entomological Expedition from Cornell University, led by Prof. J. Chester Bradley, is spending a year in the collection and study of insects over a very extensive itinerary in South America. Most of the countries on that continent will be visited.

A Memorial to Sir William Osler.—Funds are being raised in Great Britain and the United States to provide a memorial to the late Sir William Osler. This will probably take the form of an Osler Institute of General Pathology and Preventive Medicine. Dr. Harvey Cushing, of Peter Bent Brigham Hospital, Boston, Mass., has been requested by Lady Osler to prepare a biography of her late husband, and announces that he will be grateful to anyone who will send him either letters or copies of letters, or personal reminiscences, or advise him of others who might be able to supply such information.

Army Mental Tests in Schools.—The National Research Council announces that the mental tests which were used with striking success in the Army during the war are to be used on a large scale in American public schools. A program of group tests has been worked out which will make it possible to conduct wholesale surveys of schools annually, or even semi-annually, so that grade classification and individual educational treatment can be adjusted with desirable frequency. Prof. R. M. Yerkes is in charge of this undertaking, and the General Education Board is furnishing financial support.

The Cathode-Ray Oscillograph—In a note on its investigations of this instrument, the Bureau of Standards points out the unique value of the cathode-ray tube as a means of studying the excessively rapid alternations and fluctuations of the electric currents used in radiotelegraphy. The Bureau states that this form of oscillograph can now be designed and constructed with a considerable degree of certainty to suit a variety of different operating requirements. The device is a valuable aid in the standardization of wavemeters, and in the determination of wave forms produced by spark and other types of radio generators. Its most conspicuous usefulness is in the study of the characteristics and behavior of electron tubes, as detectors and generators of current for radio purposes. As an implement of research, permitting visual observation of phenomena previously unseen and furnishing data for new ideas and theories, the cathode-ray oscillograph performs a service that can be achieved by no other device. The Bureau will eventually publish a Scientific Paper on these tubes.

Susceptibility to "Ivy" Poisoning.—In the disgraceful chaos of popular plant nomenclature—which English-speaking botanists ought to set in order at the earliest possible moment—a certain species of the genus *Rhus*, neither related to nor resembling ivy, is known as "poison ivy." Having thus relieved our feelings, we proceed to say that a valuable paper on the subject of "Ivy and Sumac Poisoning" has recently appeared in the *Public Health Reports*, and will, presumably, be distributed in separate form by the Public Health Service, Washington, D. C., to a great many applicants for information on this important subject. The authors are Drs. E. A. Sweet and C. V. Grant. One feature of the paper that seems especially worth quoting here relates to the question of susceptibility. It is well known that many people regard themselves as immune to the poisonous effects of "ivy," boasting of their ability to pull it up with their bare hands, etc. It appears, however, that experiments with persons of this type show that when they are subjected to prolonged exposure, or to the application of the toxic principle of the plant itself, they react to some degree, and are therefore not immune. Though varying degrees of susceptibility to the poison exist, a person may be repeatedly exposed without noticeable symptoms, only to have his pride humbled on a subsequent exposure. Some persons not ordinarily susceptible to "ivy" react to poison sumac (*Rhus vernix L.*). Moreover, certain persons who claim to be insusceptible to the effects of the leaves admit that smoke from the burning plant, which contains a finely divided but heavy dosage of the toxin, causes symptoms. The plants are most poisonous in the spring and summer.

Automobile

Use Current Sparingly in Winter.—Do not connect additional apparatus, such as electrical horns, cigar lighters, etc., to the system without taking the matter up with the factory. The surplus capacity of the system is large but there is a limit to the amount of current which the generator can produce. Use the same judgment and reason in the operation of the electric lights on a car as you do those in your home or garage. When a car is running it is not necessary to burn all the lights, the two heads and the tail are all that are required or that are of any service. When the car is standing at night, use the side and tail lights only.

Trucks for Forest Service.—The United States Forest Service has lately gone on record as in favor of the employment of motor trucks for the gruelling service in the national forests. Chief Henry S. Graves of the Forest Service does not feel that the time has yet come for the government to outfit with passenger cars the forest rangers and other officials in charge of the national forests but for heavy transportation work in the forests, particularly when the fire menace looms, he is unqualifiedly in favor of motor trucks. On this score he recently outlined his position as follows: "I believe it will be desirable in the long run to have motor trucks in the forests where the hazard of fire is large for transporting materials and men to fires and for similar work."

A New Gasoline Street Car.—The preliminary test of a new type street car devised by a well-known auto and tractor builder at the shops in Dearborn, Mich., was declared to be a complete success. The new type of car will leave ahead of the Wolverine Flyer, between Detroit and Chicago, and will race it for a time record over the tracks of the Michigan Central Railroad, and in order to be successful will have to make 70 miles per hour. The power unit which will move the car represents a new combination of functions. It is a motor, an air compressor, an electrical generator, and a heating and lighting plant all in one. All operations necessary for the control of the car are centered in the motor. All this is accomplished, it is said, with a 75 per cent reduction in weight, as compared with the power and control equipment of the ordinary electric car.

Extremely Light Auto Body.—Mention has been previously made in these columns of the influence of automobile engine design principles on the development of the aerial power plant and now we find that aerial designers are contributing to the refinement of automobile construction, especially as relates to body construction. Our contemporary, *Automotive Industries*, describes a special five-passenger Sedan body which is claimed to weigh only 120 pounds for a car of 112 inches wheelbase. These bodies are constructed on airplane fuselage principles and are of a three-ply veneer combination. The great strength and light weight of plywood permits it to act as a sheathing and at the same time contribute considerably to the strength of the structure. The veneers usually employed consist of two plies of birch with a ply of mahogany between. The thickness of the material used in the construction of the conventional auto body is one-eighth of an inch.

Motor Transportation in Palestine.—The camel is being superseded by the motor vehicle and soon cars and trucks will be numerous in the streets of Jerusalem and other ancient cities of Palestine as well as being employed for interurban transportation. The slow moving, but fairly reliable, camel is to be replaced by the faster and more reliable motor truck mechanism. The problem of transportation not only in Jerusalem but throughout Palestine is acute. The railroads are few in number and uncertain in their schedules. Most of the passenger service of these roads was suspended during the war except for the use of troops. These roads are now in such a condition as to make other means of transportation necessary. The English since their occupation have been building up the important ports of Palestine and are planning to operate a fleet of motor trucks to these places to accommodate the influx of tourists to the birthplace of Christianity and to accommodate commercial travelers. A service from Jerusalem to Damascus in Syria is also being planned.

In the Wake of the Woodsman

The Great American Formula for Converting Forests Into Deserts

By H. A. Mount

THIS country is suffering a rude awakening just now to the fact that our forests are fast disappearing. This is chiefly due to the fact that our daily newspapers have been hardest hit through the restriction of their paper supply and they have become very willing spreaders of a much-needed propaganda.

We all dislike the calamity howler. As long as our favorite daily paper comes out on time and in its usual proportions we are likely to pay little attention to the front-page announcement that the supply of pulp wood in the United States is three-fifths gone, and that we are now dependent on Canada for two-thirds of our paper. And what if our Department of Agriculture solemnly warns us that unless we stop wasting our forests they will be gone in another fifty years? Fifty years—plenty of time to find a remedy and what's our Department of Agriculture for, anyway?

But there are times when optimism amounts to bad judgment and the man who pretends optimism about our national forests is poking his head in the sand. We need not wait a half century to see the results of a wasteful use of our forests and the lack of governmental care.

China's example is notorious. Once her lands were just as fertile and her forests just as "inexhaustible" as our own. Today these same vast areas are deserts that support no life—animal or vegetable. The reason is that China cut off her forests with the same reckless abandon with which we are destroying ours.

But we need not go to China for a horrible example. We have within our own boundaries the beginnings of deserts that are the direct result of cutting off our forests and subsequently neglecting the land. In two former articles we have dealt with the effect on our industries of our diminishing forests. In this one we shall consider the result to the land. This constitutes a more potent threat to the nation's future than any possible harm to industry, because it affects the fertility of the soil, the flow of rivers, the winds, the very climate of the continent. We can already begin to see bad effects, but appeals to stop the destruction so far have fallen on deaf ears.

There is hardly a spot in the United States where one needs to go farther than ten miles from home to find examples of the erosion of the soil that follows cutting of woods from hillsides. From these it is easy to imagine the widespread devastation that comes from cutting off the timber of large mountain areas and then allowing the remaining vegetation to be killed off by repeated fires. There are many such areas in this country. Some of them have been standing barren for thirty years or more and are already potential deserts. Most of them have simply been rendered worthless and have been abandoned.

In the Manti national forest of Utah there are two eroded areas of nearly 50,000 acres each. Parts of North Carolina that once were cultivated now are eroded and abandoned. All over the New England States are small areas abandoned because of erosion.

"Every drop of rain that falls on more or less exposed soil," says a bulletin of our Department of Agriculture, "has the power of removing soil particles, and with them the soluble salts essential to plant growth."

Trees and plants break the force of falling rain and form reservoirs which prevent the water from forming rivulets which might cut deep gullies in the soil. The leaves and stems of plants and trees drip water for some time after a shower. The roots form a path of entrance to the soil and give the earth a spongy quality.

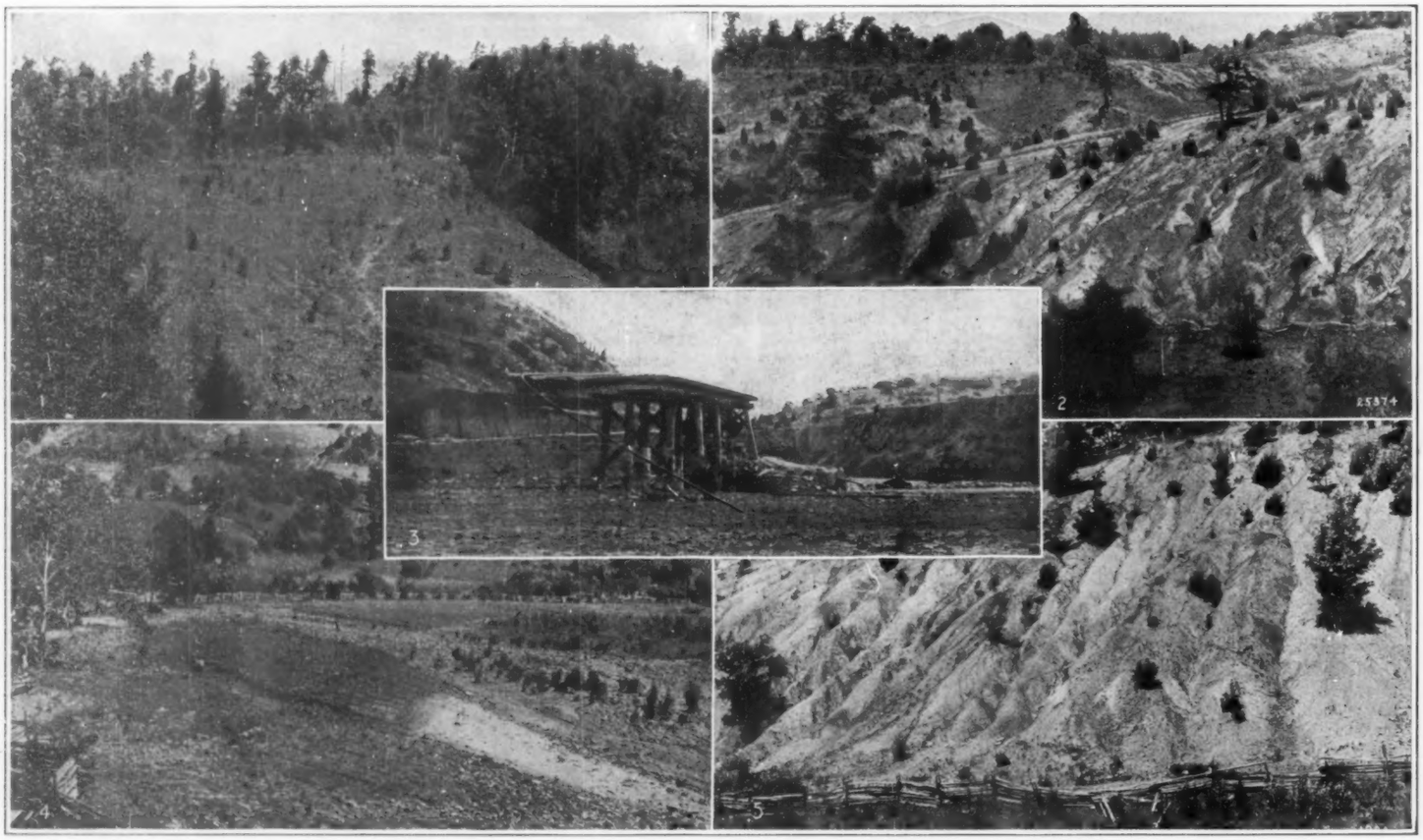
If the vegetation is gone the water quickly flows off, carrying with it part of the soil, and leaving behind stones and rock. As the waters combine and gather force their destructiveness increases. Creeks and rivers are overflowed and roads, power plants, property and even lives are destroyed.

China sees an extreme of this condition every year in the floods of her great Yellow River. Thousands of lives and countless millions of dollars' worth of property have been destroyed by this one river. In this country the Yellow River has a promising understudy in the Ohio. Nearly every year Pittsburgh and Cincinnati and many other towns and cities on its banks are flooded with disastrous results, principally because the forests of the West Virginia mountains, where the Ohio River has its headwaters, have been cut down.

The effects of erosion are not felt so keenly in the East as in the West, however. In some districts which depend on a natural watershed for a continuous supply of irrigation water, the flow has become erratic through erosion of the soil. Spring freshets send tumbling down into the irrigation ditches a great quantity of water, but in the summer when water is most needed the streams are almost dry. Many live-stock growers have made the discovery too late that cool forest shade and running streams in summer are almost indispensable to them.

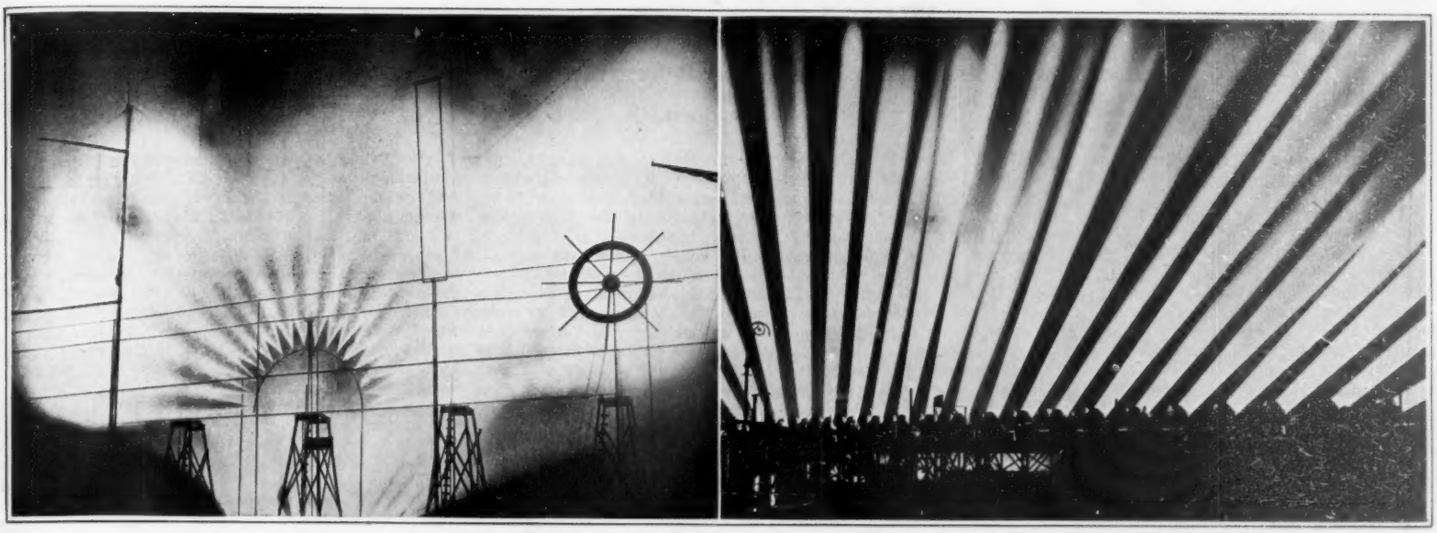
The worst feature of erosion is that the land is not simply denuded of its vegetation and gullied by rain, but the very fertility of the soil is destroyed. It will not support the plants which once grew on it

(Continued on page 137)



1. Very steep, rocky, washed land formerly cultivated in tobacco. North Carolina. 2. Deep gullies on abandoned hillside land on tributaries of Cane Creek, Mitchell County, North Carolina. White pine is slowly restocking this area, but the erosion is so rapid that seedlings with difficulty secure a permanent foothold. 3. Trout Creek, about five miles from Buena Vista, Colorado. Trestle of railroad left standing in midstream after washout in spring. 4. A seven-acre field badly washed by freshets. The top soil was eroded to a depth of from one to three feet in broad channels across the bottom. Where the soil has been eroded it is too rocky and sandy for cultivation. The land had just been plowed and planted in corn, and the lines of the furrows can be clearly seen in the unwashed place in the middle of the foreground. 5. Eroded slopes in North Carolina.

Some examples—and there are hundreds of others—of what happens in regions where the woodsman's axe has been freely used



Left: Some of the "fireless fireworks" effects produced by means of steam and incandescent searchlights. *Right:* A battery of incandescent searchlights.

Two striking examples of what may be done with the incandescent searchlight

The Last Word in Searchlights

By E. W. Davidson

IMAGINE attaching a searchlight to the lighting circuit in your house some night and throwing a beam so powerful that a man standing a mile away in this beam would have light enough to read a newspaper. It can be done. This is not to say it will be done often, however, for various protective devices would be necessary. But the incandescent searchlight which can operate on either an alternating- or direct-current circuit with proper auxiliary devices has established itself, replacing arcs of medium size for many purposes.

The first use of the new type of searchlight for spectacular effect was made at Saratoga Springs on the night of June 19 when that city turned on its new street lighting system in the midst of an illumination carnival. The powerful beams of 18 searchlights, playing through the heavens that night, were cast by incandescent lamps—a fact unknown to most of the thousands who witnessed the celebration.

These 18 beams wrought skilfully produced columns and curtains of steam into great, soft-tinted phosphorescent fans and plumes. They streaked the black sky with beauty, tracing bombs up into the night and dyeing little clouds of powder smoke with variegated tints. They turned the glare of ordinary fireworks into a radiant effulgence such as few Saratogans had ever seen. Their brilliant light helped make memorable the Saratoga festival of light.

But their use is by no means limited to gay, spectacular illumination. The incandescent is fast replacing the arc in searchlights of the type used by river steamers and coastwise vessels. Where a tower or high building facade is to be flood-lighted, the incandescent searchlight supplies accurately directed beams for the high points which are too dimly lighted by ordinary flood lamps. Where construction is proceeding at night and distances or heights are beyond the reach of smaller reflectors, these searchlights, ranging from a few hundred thousand up to ten or eleven million candle power, are playing their parts.

The new type of searchlight is the natural outgrowth of the lamp which succeeded, in the parlor stereopticon, the sputtering arc which did such doubtful service in the hands of amateurs. That stereopticon incandescent was such a marked improvement in steadiness, simplicity and economy over the arc that it was developed into proper sizes for small and medium moving picture projectors. The next step into the searchlight field was certainly a logical one.

Certain illuminating engineers who made the searchlight of both arc and incandescent types what it is today, labored long before they found the best method of shaping and mounting filaments so as to secure concentration of the light source in the incandescent lamp sufficient to produce a strong beam. Tungsten wire of various diameters wound into helical loops was tried in long coils and short—and even in a conical shape—but exhaustive tests showed that three types were superior to all others.

In a 115-volt, 1,000 or 1,500-watt lamp capable of producing from one to two million candle power in the beam, six perpendicular coils of filament are mounted in the formation of the letter C, the convex side of this arrangement being presented to the mirror.

The other two secure greater concentration for longer throws by operating at far lower voltages with corresponding higher currents. A 32-volt, 1,000-watt lamp good for about four million candle power has four perpendicular coils mounted at the corners of a close square. The third and most powerful of all is a 12-volt lamp of 100 amperes capable of developing as high as twelve million candle power in a beam of 3

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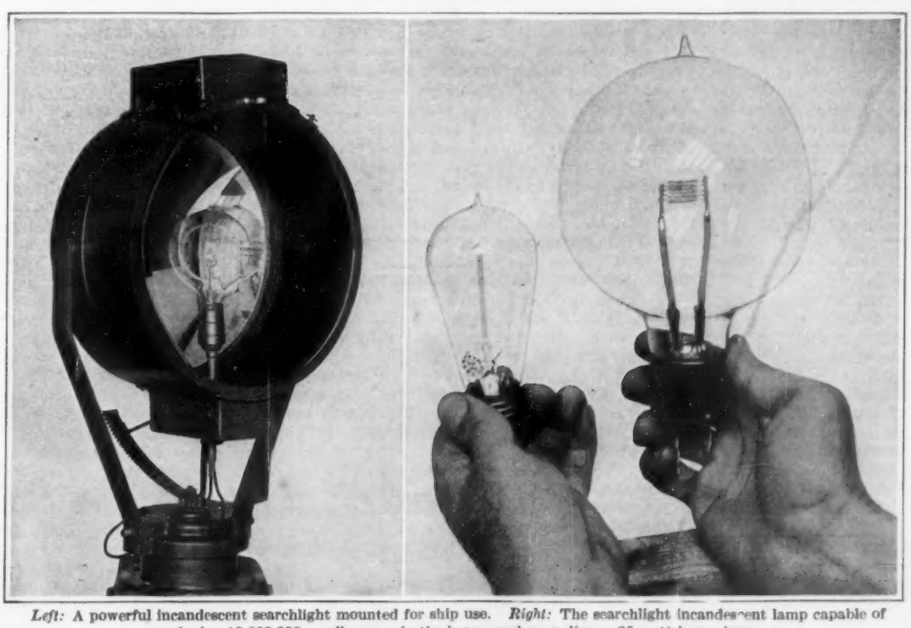

Left: A powerful incandescent searchlight mounted for ship use. *Right:* The searchlight incandescent lamp capable of producing 10,000,000 candlepower in the beam, and an ordinary 25-watt house lamp.

The incandescent searchlight and the lamp which made it possible

Guiding Ships by Electric Cables

By M. Tevis

DURING the war, while Germany held possession of Heligoland, the waters surrounding that famous island were, of course, densely sown with mines. Furthermore, in that vicinity dense fogs are very common, while, too, the mouths of the Elbe, the Weser and the Jahde are marked by violent currents and very high tides which make this part of the North Sea particularly difficult to navigate.

German ingenuity set itself to work to find some safe method of entering in and out of port during those hours when the fog covered them and protected them from the British lookouts. They did hit upon such a method and some time afterward it was discovered and utilized by the British, which enabled their navy to navigate without too much danger among the mine fields about Heligoland. A description of the process employed has lately been made public by Sir Arthur Evans, President of the British Association for the Advancement of Science.

To begin with, electric circulating cables carefully protected by metal coverings against fraying at the bottom were fastened to the ground at one end near a station possessing powerful alternators for sending alternating currents. All of the ships were provided with precision instruments which by induction were influenced by these currents in proportion as they approached the vicinity of the cable or, more exactly, when they came above the cable, at which moment the records of the registering apparatus grew fainter or slightly changed direction before reaching a maximum once more.

Some of these one-direction cables were as much as 90 kilometers long, and Sir Arthur Evans declared with enthusiasm that the captains of vessels became able to follow the cable at any speed whatever as easily as the street car follows its rails. It is obvious that this ingenious device is destined to give tremendous service in time of peace, as well as in time of war, especially in ports where the channels of approach are devious and difficult to follow and where there is much fog, both conditions being considerably prevalent along the English coast. From the moment a ship "picks up" the outer end of the cable, the man at the wheel need no longer be troubled by reefs, shallows and currents or even by fog.

Two cables have already

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Who Invented It First?

Some of the Knotty Points That Come Before the Examiners in Interference

By John Boyle, Jr.

SOME one has said that there are three critical periods in a man's life: when he marries, when he starts to build his own home, and when he begins to raise chickens. To these might well have been added a fourth: when he begins to invent. There is no general appreciation of the number of people in this country who show a disposition to invent. The reports of government officials show that more than 70,000 applications for patents were filed in this country last year, representing substantially as many American inventors. There are over 600,000 unexpired patents which represent conservatively half a million living American inventors. It would not be an exaggeration to say that there are probably one million present, past, and prospective inventors alive in this country today.

With so many individuals interested in the subject of inventions it is not at all surprising that there should be times when their paths cross and conflicts arise as to the origin of some specific invention. Whenever the attention of the public is focused on some great undertaking, individuals in all parts of the world begin to devote their attention to the solution of the pressing problem. During the war when the submarine activity was at its height, the British Government received, in a few months, not far from 40,000 suggestions of ways and means to curb this menace; the number of suggestions received by our Navy Department far exceeded this. After the Iroquois Theater fire in Chicago some years ago, all kinds of protective schemes found their way into the Patent Office. The same thing happens after every big train wreck, or any other calamity the news of which is spread nationwide. A multitude of applications for patents were filed after the announcement of the sale of a concrete fence-post invention for a quarter of a million dollars; and also after the publication of the sale of the patent rights of the autographic kodak invention for a large sum. And it is entirely obvious that when a lot of people—scores or hundreds or thousands, as the case may be— get to work on the same problem, a lot of them are going to produce solutions which to all intents and purposes are identical.

Whenever two or more applicants come into the Patent Office claiming a patent for substantially the same invention, some method must obviously be devised in order to determine to whom the patent shall be granted. Only one valid patent can be granted for an invention, and under the law it must be granted to the original and first inventor thereof provided he has been diligent in reducing his invention to practice either by the construction of an actual working model or the filing of an allowable application. The question therefore to be determined is, which one meets these requirements. The proceeding which is instituted for this purpose is technically known as an interference proceeding. Every year nearly a thousand of these contests are instituted of which about one-third come to a final decision. There are two important facts in the development of an invention which it is necessary to understand in reaching a decision as to who is the prior inventor and hence entitled to the patent. One is known as conception of the invention and the other as reduction to practice of the invention.

Whenever a person begins to invent, the first step is in appreciating the desirability of doing something in order to fill a certain want. There then comes to the mind of the inventor some specific means for accomplishing the desired result. Ultimately he is able to make a sketch or a model or a working drawing thereof. When he has proceeded thus far he is said to have a complete conception of the invention. In other words, he has in his mind a definite scheme as to how he intends to construct his machine for accomplishing the desired purpose. He is not considered to have invented anything until he has reached this stage in the perfection of his ideas.

In order to perfect the inchoate right which the inventor has acquired through the conception of the invention he must now proceed to demonstrate the practicability of his device for the purpose for which it was intended. The fact that an inventor has made a drawing of his invention is not always conclusive that it will do all that it is intended to do. This can be demonstrated by subjecting it to an actual test under the conditions that would exist in practice; or as a substitute for this test, the inventor can perfect his inchoate right by filing an application for patent. This is designated in the law of patents as a constructive reduction of the invention to practice.

The pervading idea in the whole system of our patent laws is to benefit the public. As a reward for conferring this benefit on the public the law gives the inventor an exclusive right to make, use and sell his invention for a term of 17 years. This right will not be conferred if there is any doubt as to whether the invention will do all that is claimed for it. Hence the requirement as to reduction to practice.

Several different sets of conditions arise in these contests between rival claimants for a patent for the same invention. The most common is that between independent inventors; let us take such a case and see by what rules it would be decided. John Doe, a professor of physics at Harvard, wishing to contribute his little bit to winning the war, begins to devote his attention to finding a device that will detect and locate an enemy submarine. After much speculating and planning, in December, 1916, he has such a definite notion of an apparatus that will do this that he is able to make a drawing of it in complete detail. He takes this drawing around to one of his fellow professors and explains to him his whole scheme and is greatly encouraged by the favorable comment. Thereupon he begins to wonder how he is going to test out his device and demonstrate with certainty that it will do all that he expects it to do. While still considering this phase of the problem and before taking any definite steps to this end he hears that considerable trouble is being experienced by the allies in finding an effective gas mask. He thereupon lays aside his submarine detector and takes up the problem of inventing a successful gas mask, prosecutes the investigation with vigor, and by July, 1917, he has developed a gas mask that meets with the approval of the military experts. Stimulated by the success he has won in this field, he returns with renewed effort to his submarine detector. In September, 1917, he sends the drawings of this to his attorneys for an investigation of its patentability. The report is a favorable one and on October 1, 1917, he files an application for patent.

The scene now shifts. Comes Richard Roe, professor of physics in the University of California. Embued by the same spirit of patriotism as John Doe, he too begins to experiment with submarine detectors. He has reached such a point in his investigations by February 22, 1917, that he is able to make a drawing of his device, which he immediately sends to the Navy Department. Favorably impressed with the apparent utility of the detector, the Secretary of the Navy wires him to report at once to the Mare Island Navy Yard in order to have his detector tested. At a test carried on under the supervision of the yard officers he is able to detect the direction and distance of a submarine within a radius of twenty miles. On December 20, 1918, he files an application for patent.

Now the officials of the Patent Office had decided only a few days previously that John Doe was entitled to a patent for his submarine detector. But Richard Roe's detector is a Chinese copy of John Doe's. To whom shall the patent be granted? To Richard Roe, even though he was the last one to think of the device, the last one to make the drawing, and the last one to file an application for patent! But he has this all powerful fact in his favor: he was the first to reduce his invention to practical form, the first to go from the depths of probability to the field of certainty. His device will do all that is claimed for it because it has done it. If he were to die the day after the test he would have left behind him for the benefit of the public a definite and certain addition to the sum of human knowledge. His ideas would not have been clothed in speculation and uncertainty.

Now in all fairness it would seem that if John Doe was the first one to think of the submarine detector he ought to be prior in right to Richard Roe. And so the law does say and do, but with a snapper proviso on it. The reason that John Doe lost his right to a patent was because after he had conceived the invention he temporarily abandoned the idea to work on the gas mask. During the period that he had laid aside his invention, Richard Roe, unaware of the prior activities of John Doe, entered the field, conceived and reduced to practical form his own detector.

The hard lesson that John Doe has learned should be a warning to all inventors. If you are an inventor and have a definite conception of your invention, either hasten it to completion and actual test or file an application for it in the Patent Office. The first course is the preferable one, but if that is impossible then the second course should be followed. The law says that you must be diligent in reducing your invention to practical form otherwise you take the chance of some more diligent rival cutting the ground out from under you.

It may not be an inopportune time now to issue an additional warning to inventors. From a patent standpoint nothing is quite so fatal to an invention or discovery as secrecy. Of course if an inventor prefers to manufacture by a secret process and is certain that he can keep it secret, there is no objection to such a procedure. The inventor and manufacturer of a leading photographic paper has done this to his great financial benefit. But the situation under consideration here is where two or more inventors are seeking a patent for the same invention. The one will secure the patent who is able to prove the earliest acts of invention, that is to say, the date and character of his conception and also of his reduction to practice. Now if he has kept in his own heart all that he has done along this line he will have no evidence in the eyes of the law wherewith to prove that he has done what he claims to have done. It behooves every inventor, therefore, to keep some individuals—who are competent to understand and to testify to those facts if necessary—informed of all that he is doing in the line of inventing. Unless it is a very simple device it will not avail much to disclose it merely to your wife or your mother-in-law. Being interested parties, too, their testimony is not entitled to much weight.

The fear of having an invention stolen is something that seems to obsess many inventors and is probably the reason that impels them to secrecy. There were probably more Liberty bonds stolen on any day last week from reasonably secure places of deposit than of attempted steals of inventions in the whole history of the Patent Office. The inchoate right to a patent has been threatened oftener by the veil of secrecy than by the crime of thievery.

One of the most interesting and leading cases of the penalty of suppression and concealing an invention was decided in 1902. An inventor, Mason, conceived the idea of a certain kind of gun-clip, had it made and applied it to a completely finished gun. The invention was a simple device and complete in all its details. It was put away in the model room of the company which employed Mason and was entitled to the benefits of his inventions. No clips of this kind were put on the market and the gun and clip were never exhibited to the public. Seven years after the completion of the invention another inventor by the name of Hepburn, unaware of the activities of Mason, filed an application

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THE troubles of the inventor in interesting capital and getting his invention developed are an old story. Perhaps a little less familiar are some of his troubles in getting his invention past the gentlemen in the Patent Office whose duty it is to discover whether the alleged features of novelty are really new or not. It is obvious enough that if we reinvent independently and unknowingly something that has already been invented and patented, we can't expect the Government to give us a patent on it in return for "disclosing" it. What is not quite so plain, however, is that even in the absence of a prior issued patent we may have nothing that is entitled to consideration as new. How the patent examiners decide between the claims of two men who come before them with substantially the same invention, and how these men can best protect themselves in advance against an adverse outcome in such a case, are the things that Mr. Boyle tells us in this article.—THE EDITOR.

The Metric System

Why We Should Measure in Meters, Grams and Liters, without Reservations

By Herbert T. Wade

THE growing and active interest in the serious discussion of the necessity of adopting the metric system in the United States has been reflected recently in the correspondence columns of the SCIENTIFIC AMERICAN. This paper for many years has believed that the adoption of the metric system, logical in its development and international in its application, would accomplish as much for manufacturing and other industries, commerce and the ordinary transactions of life in the United States as it has done in continental Europe and also in purely scientific work where its use is now universal.

It is always difficult to convince the general public of the desirability or even necessity for changes in weights and measures, and it is the experience of history that such reforms as well as those of the currency and coinage always must originate with a few enlightened and far-seeing persons and be forced upon an indifferent or hostile public. Even in matters of such vital importance as fraudulent weights and measures, false statements of quantities and similar matters, there rarely is evident any general demand either for legislation or for the enforcement of statutes bearing on this subject, and what has been accomplished has been done through the interest of a few rather than in response to the demands of the many.

Again the Apathetic Public

Accordingly, while the matter of weights and measures both ultimately and directly concerns the general public and it is widely realized that American and British weights and measures are dissimilar, illogical and inefficient, yet it must be admitted that today there is voiced in neither country any widespread and compelling demand for changes and improvement. But as always there are now scientific and public-spirited citizens advocating reforms which are as vigorously opposed by others. As a result the people of the United States have been treated to an almost endless discussion and argument by two hostile camps composed of enthusiasts, propagandists and controversialists, comparatively few in numbers, with whom the calm consideration of facts in the light of experience, the analysis of conditions and underlying theory, and the technical, economic and logical development of the question too often have been conspicuously absent.

With the great mass of the people indifferent to metrological reforms it is all the more the duty of thinking men and women to examine the arguments and conclusions developed by those who have given study to the matter, and most of all the underlying facts, record and experience. As a consequence they will be forced to espouse one of the three following propositions: First, that there are no reforms necessary in the American and British weights and measures; second, that the existing American and British systems of weights and measures, with their duodecimal and binary system of subdivision, can be simplified, harmonized and referred to common standards with more or less modification to a decimal basis; third, that the international metric system, now in universal use throughout the world for all scientific measurements and in commerce and industry in the majority of civilized countries should be employed universally and by statute in America and Britain.

Why the Metric System?

For each of these points of view arguments can be and are advanced, but, in our opinion, experience and logic are overwhelmingly in favor of the adoption of the international metric system, and especially if it can be carried forward on a sane and progressive basis, with due regard to the interests of all.

And this in no way contemplates the impossible or impractical. No one proposes arbitrarily and immediately to change to a metric basis such standards as railway track gage, airbrake hose, couplings or other railway fittings. But it does mean that for new types of material and new types of construction not only metric but international and universal standards should be used.

Decimal coinage has demonstrated its supremacy throughout the world, and so far as calculation and reckoning are concerned, there is no more reason for the survival of the Anglo-Saxon weights and measures as a system than for the system of currency based on pounds, shillings and pence, which progressive thought in England desires to change. It requires only a recollection of school day arithmetic to recall complicated tables with many and unnecessary units used only by those directly concerned with a special trade or calling, and the inevitable question comes, Why is the capacity measure for a liquid different from that for a dry material, or why is a bushel different in different parts of the United States? Furthermore there is not today harmony in the weights and measures of the two great English-speaking countries either in systems or standards; tons, gallons, bushels and other units are absolutely different. Though the yard, foot and inch are the same in both, yet, as a matter of fact, they now are ultimately referred to the standard prototype meter for their precise definition.

Argument Based on Conservatism

While some favor a binary or duodecimal system from a spirit of conservatism and for alleged facility in construction, especially in hand work with dividing or foot rule, yet in actual practice these points of superiority rarely appear, at least as important elements. Of course, on the Anglo-Saxon systems of the two great nations have been built many machines, and engineering and other information have been compiled either in an extensive literature, or in valuable tables, which with any change would be rendered obsolete or require transformation. However, so far as material things go, much here is obsolete or obsolescent, change or no change, and if what is to come in design or construction or a literature or tables can be devised on a new improved and universal system, inconvenience and incidental loss would be far less than feared.

A partial change would cause practically as much inconvenience and trouble as the adoption of a new system, and the only elements that would be maintained would be the linear units and standards, with perhaps the avoirdupois pound and even for them a new and decimal subdivision is proposed. With the difference between the American and British ton, the American and British gallon, the American and British bushel, there would be important adjustments necessary in at least one of the two countries that stand pre-eminent in the world's trade, while so far as linear measurements are concerned, and here the large machine tool and manufacturing industries are concerned, any modification or readjustment of the Anglo-Saxon measures would lead to almost as much confusion as an entirely new system.

How to Save Clerical Work

Advocating the international metric system, therefore, it is not necessary to advance the familiar arguments, many of which are sound, but to suggest a point of view that we think has been to a large extent overlooked. In modern American manufacturing cost analysis and accounting has become as general as it is necessary, and this involves considerable clerical work and calculation. Even today the metric system could be introduced into much industrial work with small expense in the way of providing suitable weights, measures, scales and weighing machines, and in the control of processes the data at any stage would be secured and handled with much less effort and clerical labor. Just as a decimal hour is used in many establishments, beginning with the raw material it would be possible to employ metric weights and measures in every stage until the final product with a considerable saving and increased efficiency. In an establishment we have in mind, a practical industrial engineer informed in weighing and measuring methods, both scientific and practical, estimated that a saving in clerical labor representing between five and ten thousand dollars per annum would be secured by recording all weights and measures in the metric system, eliminating the inconvenient avoirdupois and troy systems, both of which were used in this special plant.

There are certain industries or certain departments of large industries, where such an experiment of introducing the metric system exclusively could be carried on for one or more years with every prospect of material advantage; and it is to be urged that this be done under enlightened and scientific direction by such corporations, and that the results be described to some convention of mechanical or industrial engineers. Such work on a partial scale is done in some mechanical and electrical manufacturing plants in the United States and in a few concerns working from European plans or European orders, without, so far as can be learned, the slightest embarrassment or difficulty, but it is urged that this method be tried as an efficiency measure and the experiment should be well worth the effort. Indeed to many engineers who have given thought to the matter the practical efficiency of the use of international metric weights and measures is a single argument sufficient to warrant its adoption.

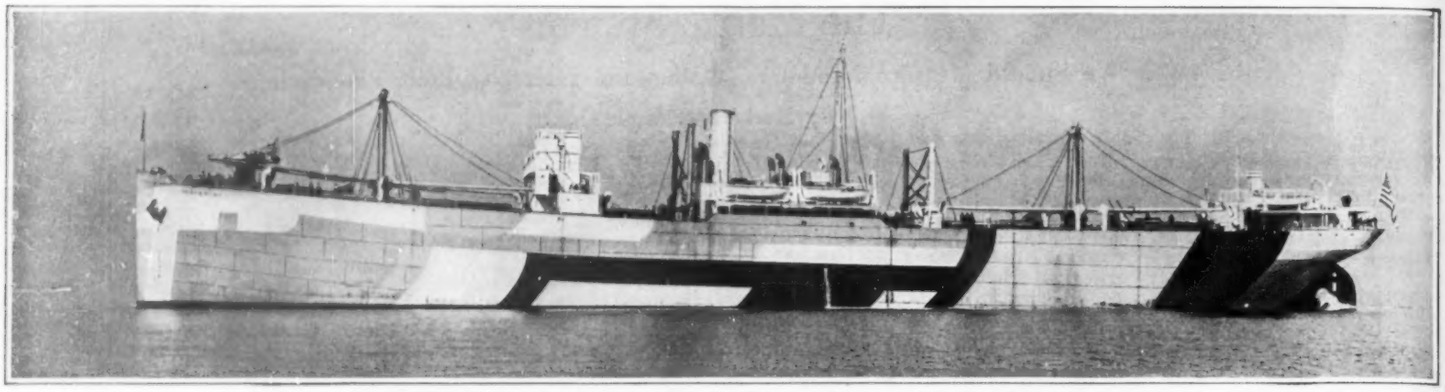
The Serious Matter of Screw Threads

In manufacturing the mere branding of a product with its metric equivalent is a simple step, which will prove at once advantageous to foreign trade and one that can be recommended as distinctly worthy of adoption. The crux of the situation in the United States as regards the adoption of the metric system confessedly lies in the enormous and efficient machine tool industry, where standards have been followed both of individual manufacturing concerns and those conforming in general to accepted practice and based on the Anglo-Saxon system of units. In these the matter of screw threads plays an important part, and an American system has been evolved, while abroad is found a British standard system, and also one based on the metric system in less common use, known as the International System. Commissions are now concerned with the study of the American and British screw-thread systems, and of international standards in general, and it would seem to be a proper time to take action to secure an international standard which in future construction could be used. It would be desirable to have such a system based on the metric system rather than on the American or British system exclusively, and it might be suggested as worthy of the attention of an International Engineering Commission or Congress to evolve satisfactory and efficient systems of screw threads that could be used in future construction for articles designed for international commerce, and particularly for new types of machines whose construction is about to commence. Mechanical engineers in all countries must realize that production must be carried on with a view to the markets of the world, and that international standards must prevail if any individual country hopes to secure its proper place in the world's markets. The time has passed when a single nation can impress itself and its products by force on any other nation and compel acceptance of ideas and articles, and international weights and measures are distinctly in line with the progress and enlightenment of the times.

Mechanical Bond in Reinforced Concrete

MUCH ingenuity has been displayed by inventors in the production of patented bars and other forms of reinforcement for concrete, generally, but not invariably, with the object of providing a mechanical bond to supplement the grip or adhesion between the concrete and the steel, says a British writer. As remarked by Professor Turneaure, "America is the home of the patent bar," for European engineers generally agree that the natural adhesion bond between concrete and embedded steel bars is quite sufficient to comply with essential conditions. Nevertheless, it may be at once admitted that a supplementary bond is worth securing, if the form of the bar is one not likely to cause undue strain in the concrete and if the cost of patent bars is not too high.

Many forms of patent bar are made with swellings and other projections which tend to split or shear the concrete, if the bond stress exceeds the usual working limit, and all forms of such bars cost considerably more than plain bars. So far as concerns safety from excessive strain, a good form of patent bar is one giving a continuous mechanical bond furnished by a helical surface formed by twisting bars of square or special section either after or during the process of rolling. If the operation of twisting is performed with due care after rolling the yield point and ultimate strength of the metal are raised to an important extent, while at the same time the bars are not subject to the small amount of permanent set which occurs in plain bars after being loaded for the first time. Therefore, twisted bars may provide a higher factor of safety as well as a continuous mechanical bond. In the case of bars twisted during the process of rolling the physical properties of the steel remain unchanged, but this method of treatment should lead to the production of mechanical bond bars at minimum cost.



The 12,000 ton (deadweight) "Invincible," built on the Isherwood longitudinal system

Our Deep-Sea Freighters

Something of Permanent Advantage that We Got from Our Participation in the War

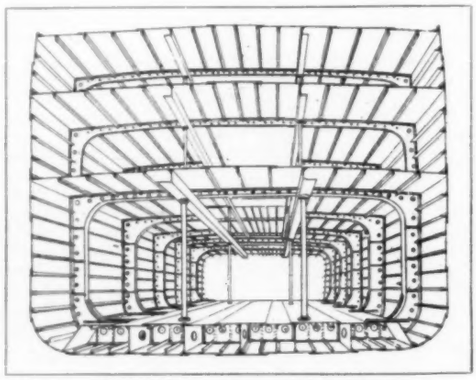
By Robert G. Skerrett

THE test of time is going to tell in our favor and bring out the fact that we fought in the World War to our lasting advantage, and this, in a sense, apart from the immediate consequences of our participation in that conflict. That is to say, the urge of strife spurred us on to achievement in one direction or another where we might otherwise have hesitated for years.

This is undoubtedly true in regard to our sudden and spectacular creation of a really formidable array of deep-sea shipping. Our newly revived merchant marine will be a worth-while aftermath of the recent struggle if we prove wise enough to make the most of these craft and to profit by what we learned in bringing them into being. It is true that mere expedition of construction cost us doubly dear in many instances, but, even so, the price was not exorbitant provided we put the sound knowledge gained to good account. That is to say, pick out the types of steamers that have since revealed their merits in service and then reproduce their kind as occasion requires—sedulously avoiding, of course, the duplication of ships that have not measured up to peacetime standards.

Among the array of vessels constructed in our various yards, the public at large has heard little about two 12,000-ton freighters built at Alameda. Not only were these boats turned out in a remarkably brief time, but they represent an order of hull get-up characterized by qualities calculated to command the attention of marine architects, shipowners and the operators of oversea cargo carriers. The steamers in question are the "Invincible" and "Courageous."

These craft were of a group of single-screw steel vessels actually in hand at the California yard for the Cunard Steamship Company when we joined forces against the Central Powers. Subsequently, the "Invincible" and the "Courageous" were requisitioned by the Emergency Fleet Corporation and completed and commissioned by that organization. The keel of the "Invincible" was laid on July 4, 1918, and the boat



Cross section of Isherwood system, showing arrangement of deep frames and deck beams

was put overboard on August 4, following, the actual working time being 23 days and 23 hours. She had her trial trip on October 11th, and was duly delivered to the Government authorities five days later. The keel of the "Courageous" was laid on July 4th; she was launched on the 22nd of September, and on the 27th of November she made her trial run and was likewise delivered to the representatives of the Emergency Fleet Corporation. Despite the fact that these freighters were constructed very rapidly they were nevertheless subjected to exacting inspection and were given the highest classification according to Lloyd's register of shipping. This climax was in part due to the method of construction adopted, which lends itself to both quick and thorough work.

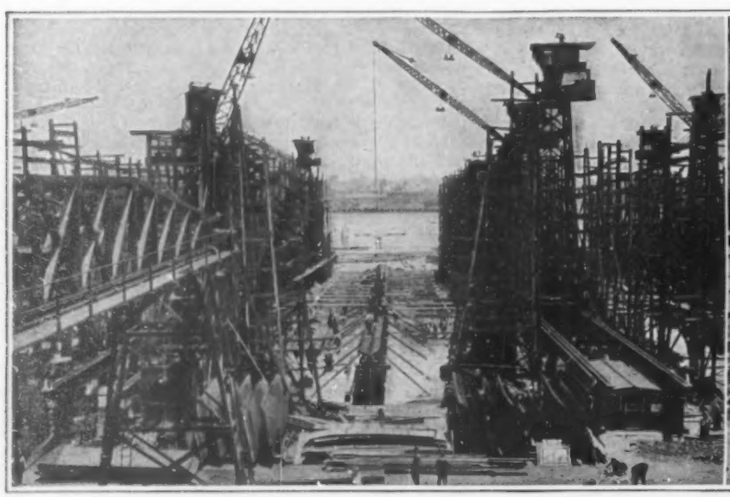
For the sake of those interested in figures, the following particulars of the two ships will probably be acceptable:

Length between perpendiculars	440	feet	
Breadth molded	56	feet	
Depth molded to upper deck	25	feet	6 inches
Depth molded to shelter deck	38	feet	
Height of 'tween decks—top of beam to top of beam—at side and amidships	9	feet	6 inches
Deadweight tonnage	12,000		
Maximum mean draft	27	feet	7¾ inches
Block coefficient about	.797		

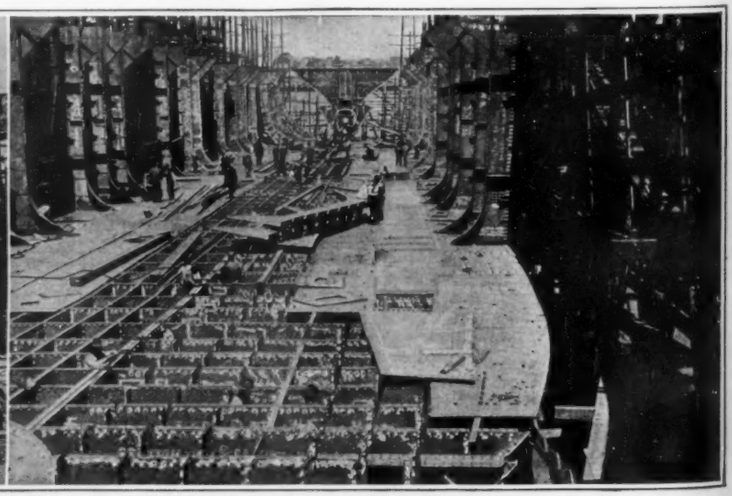
These vessels are built upon what is known as the Isherwood system of longitudinal framing, have straight stems and elliptical sterns, with a complete flush steel shelter deck. They also have a steel upper deck extending from bow to stern, and the living accommodations are located in three steel houses on the shelter deck.

Each ship handles its freight through five main hatches in addition to a hatch leading into the deep tank—the latter, which is abaft the engine room, is suitable for either cargo or water ballast. The double bottom which is built upon the cellular system has piping to five of the six transverse compartments which

(Continued on page 139)



Laying the keelplate, July 5, 1918

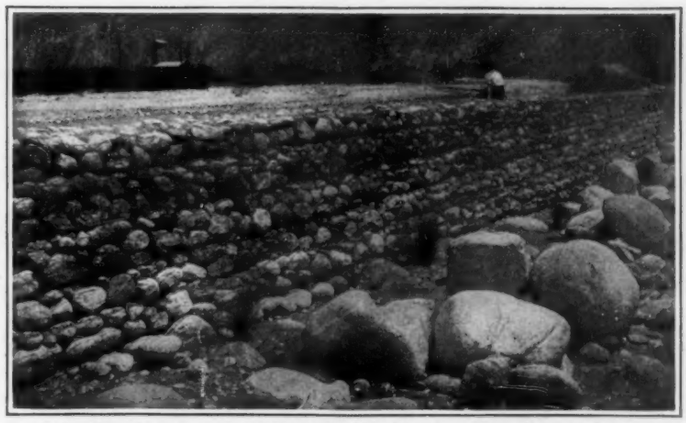


The condition of the work July 9, 1918

A River Wall in Which Wire Mesh Replaces Mortar

A TREACHEROUS southern California mountain river, the San Gabriel, subject to tremendous floods, was held in check the past winter and spring by a wall constructed without mortar or cement. Instead of the interstices being filled with such a binder, the boulders of which the protective barrier is built are firmly held intact by heavy galvanized mesh wire, as shown in the photograph. It withstood the mighty rushes of water without a sign of weakening and saved the main highway heretofore washed out annually. This highway runs parallel with the river along a mountainside and the wall stands between it and the stream. The rubble was laid in tiers or terraces about a foot and a half deep, that at the base twelve feet wide and that on top four feet. The structure is ten feet high and 600 feet long. This wall was built with prison labor by Los Angeles County at a time when cement was obtained with difficulty, and was somewhat of an experiment; but it proved cheaper and fully as staunch as flood structures of stone and cement.

The success of this novel means of protection against floods will no doubt lead to its adaptation in many places where efforts to control sudden floods have hitherto proved futile.—By *John L. Von Blon.*



Galvanized iron mesh held this wall of boulders together, the wall, in turn, holding the San Gabriel River to its course

The Ready-Cut House in France

FRANCE has always been the country of the stone house—the substantial structure built by the industrious Frenchman who thinks not in terms of the immediate future or even of his lifetime, but of future generations. Of course the war has done away with thousands upon thousands of these one-time staunch stone habitations, and the devastated regions must be rebuilt in a more expeditious manner than the old one of stone and mortar with its time-consuming labor.

So the ready-cut house has made its appearance in France. This American invention—the house which can be bought in pieces, already cut to size and fit and assembled according to blue-print—is now popular in France. Our illustration shows several offerings of French manufacturers, recently exhibited in Paris. Despite the fact that these houses are being turned out in large numbers, they have an attractive appearance. They are said to sell at a remarkably reasonable price. But the fact remains that the Frenchman, once he can get back to his normal life, is going to rebuild France with stone houses which he can pass on down to his grand children, long after the wooden houses have disappeared. — By *Ralph Howard.*

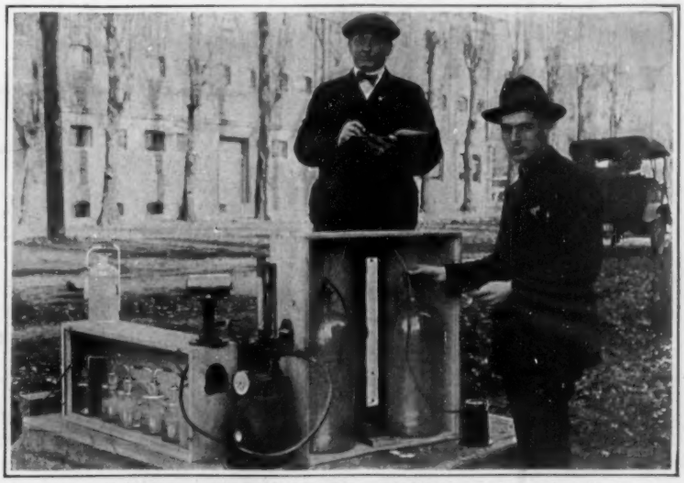
Ready-cut houses recently exhibited in Paris and sold to the inhabitants of the devastated regions

Testing the Air We Breathe

IS the air you breathe pure and is the city in which you live healthy? This is an age-old query and one which often precipitates a controversy between the denizen of the valley and the man who lives on a mountain top. The former is often pitied by the mountain-dweller because of the preconceived notion that the atmosphere of the lower levels is charged with impurities; while the reply of the citizen of the valley is, "Much of your boasted ozone on the mountains is a myth."

While the U. S. Bureau of Mines would studiously avoid agitation of such a mooted question, this Government department has devised an instrument for revealing the quantity of solid matter and the gaseous impurities in the atmosphere. For instance, if there is an excess of smoke, or other extraneous material hovering over your city this apparatus would doubtless answer the question, "Is this super-abundance of smoke, say from a foundry, burdened with impurities which are detrimental to the inhabitants of the city?" The device is in practical use in Salt Lake City, Utah.

The large bottles shown in the photograph are used for detecting and measuring of sulfur dioxide, the apparatus being capable of revealing the presence of one-tenth part in one million. The weather barometer, a part of the equipment, contains a filtering thimble which ekes out the soot and other solid material. The air is measured by the meter, and then passes through the small bottles, in the left of the photograph, which containers absorb the nitrous oxide, ammonia, chlorine and other gaseous impurities. The bottle on the box, to the left, determines the amount of carbon dioxide. A motor-driven vacuum pump, situated immediately behind the boxes, forces the air through the apparatus. The job is complete—the percentage of gaseous impurities in the atmosphere is revealed.—By *S. R. Winters.*



By means of this array of apparatus these specialists soon determine the fitness of the air which we breathe

Making American Roadsides Productive

BECAUSE the American roadside is an unsolved problem, and a big one, the announced intention of the highway department of an eastern State to plant fruit and nut trees along the roads, in an experimental way, challenges interest. In addition, provided the coöperation of the State Department of Agriculture can be won, alfalfa-growing enterprises will be launched. The state is New York—the highway commissioner, Frederick S. Greene.

The objects in view are several. There is the obvious one of beautification. The tree-lined highway is soothing and attractive. Second, there is the avoidance of an economic waste. The roadside land at present unproductive in the United States is enormous. Roadside weeds are a positive evil throughout the nation. The third object in view, of a different character, is understood best by highway experts. It is the protection of the built road. Trees tend to lengthen the life of a road because they shade it, and prevent rapid expansion and contraction.

It is a common practice in Europe to plant fruit trees along highways. The fame of certain districts in which cherry trees have been thus used has been spread all over the world. In the United States, aside from planting within villages and cities, the only regulated work of this character at all parallel is seen in apple-lined roads of the Northeast. When the American apple industry was a mere infant, and most orchards were a sideline on general farms, it became a common practice to plant apple trees in a single row along the walls and fences which bordered highways. These trees were inside the fence, yet they utilized the roadside in a practical manner, for half their root system, and a large part of the plant food they used, was in roadside soil. Tree-lined roads of this character are still to be found.

The road allowance generally in this country is liberal, and often manifested in excess of traffic requirements. The roadside land disused thus created may be worth as little as $5 an acre, as in some eastern rural sections which could be enumerated, or a matter of $300 or more an acre, as in some fertile farming sections of the Middle West. It may be land worthless for agriculture, or the most fertile of soils.

The New York plans are frankly tentative. They may culminate in a leasing system under which the roadside production of certain areas is let to farmers, or they may end in the conclusion that any administration of roadsides must be entirely public. It is suggested that, carefully handled, the roadsides might contribute substantially to the cost of road maintenance.

In the well-settled farming counties of the Middle and Far West, there is often a crying need for well-regulated administration of the roadsides. Especially has this been felt the past two seasons, when hay and pasturage being high in price and scarce called general attention to the resources of the highways.

In some communities, the farmers of a neighborhood would turn their stock out on the roads; the man owning the most stock derived the most good. In some other places, it was illegal to pasture stock on the highways, even in the care of a herder, and no provision for utilization of the roadsides was made.

The America's Cup Races

Notes on the Contests for 1920

By J. Bernard Walker

THE struggle of 1920 will go on record as the keenest in the history of the America's Cup. Perhaps this statement would be closer to the truth if the "Resolute" and "Shamrock" were being sailed boat for boat; for the races had not proceeded very far before yachting men were convinced that "Shamrock's" chances of winning the Cup, subject to the heavy burden of over seven minutes' handicap, were very slight.

Nicholson, the designer of "Shamrock," has stated that these races are practically tuning up races for "Shamrock," and it is certain that what little sailing she did against the 23-meter "Shamrock" was of little value to her; this for the reason that she so greatly surpassed the older boat on every point of sailing. "Shamrock" never had an opportunity to try herself out against a boat of her mettle until she met "Resolute." Positive proof of this is seen in the fact that she was able to beat the 23-meter boat by something like fifty seconds to the mile, going to windward, on which point of sailing if the wind holds true, she seems to be from two to three minutes in 15 miles behind the Herreshoff craft.

Weatherliness has always been a distinguishing feature of Herreshoff's designs no matter what the size or type, whether knockabouts, 30's, 50's, or 90's, or whether sloops or schooners; and it is because "Shamrock IV" was so greatly superior to the famous 23-meter boat in windward work that there seemed to be a fighting chance of her pulling out the necessary seven minutes' lead, with just a little over to score a win.

"Shamrock" foots fast enough on every point of sailing, and the fact that she is able to reach the outer mark only a minute and three-quarters behind "Resolute" in a turn to windward of ten miles, proves, to our thinking, that she must be footing faster through the water than "Resolute." Just how great is the difference in pointing, we do not know, but it must be at least a quarter of a point to put her so far to leeward on a board of any length. It is possible that Nicholson, if he had the time, could make such changes in the sailplan and in the lateral plane as would enable "Shamrock" to lie as snugly to the wind as does "Resolute"; though we are inclined to doubt it. If this could be done it is quite possible that in a series of a dozen races in winds that held true, the result might be a tie between the two boats.

Since we last went to press the "Resolute" picked up another race, thus making the series a tie. This fourth race, held over a triangular course, was sailed in a freshening breeze, the first ten miles being laid to windward. On this leg, "Resolute" pulled out a lead of one minute and forty-seven seconds. The second leg consisted of ten miles of broad reaching, and had the wind held true, there would have been another ten miles on a broad reach to the finish. Since this was generally considered to be "Shamrock's" best point of sailing, it was thought that she might save from four to five minutes of her allowance. But to the surprise of everybody on board the yachts which followed the races, her gain in ten miles was only forty-three seconds. In view of the fact, however, that this leg was sailed at a speed of slightly over twelve knots, the gain of three-quarters of a minute was very creditable. Three-quarters of a minute gain at that speed would, of course, be considerably greater if the course were covered in light winds that would require the whole six hours to complete the course.

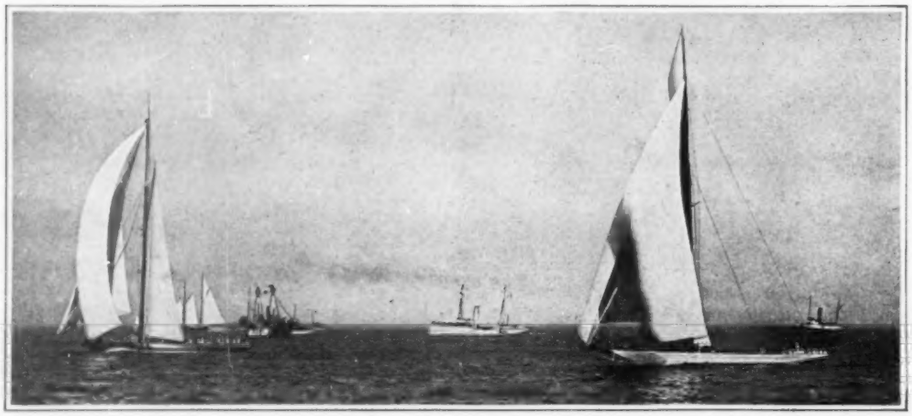
On the final leg, "Shamrock" continued to gain and seemed to have pretty well made up the remaining minute that "Resolute" had gained to windward. She was so close that "Resolute" had to luff out to prevent her passing. At this time the meteorological conditions were most unusual. A white fog bank was moving up against the wind to meet the yachts, and a black squall seemed to be about to burst upon them from to windward. The skipper of "Shamrock," realizing that there was no chance of picking up his seven minutes of handicap, determined to play safe and took in his club topsail. "Resolute," however, held to hers, and as the black squall failed to materialize and the boats ran into a comparative calm, "Resolute" was to the good as regards canvas for the rest of the race. After the wind had headed both yachts, it finally settled down to a quarter which enabled "Resolute" to come home with her balloon jib carrying a good rap full. She gained on the last few miles of this leg two minutes and fourteen seconds, winning the race by three minutes and eighteen seconds, or nine minutes and fifty eight seconds, corrected time.

The two boats were now tied with two races for each. The earlier attempts to pull off the deciding race were disappointing to the point of exasperation. On Saturday, July 24th, there was a splendid breeze of from 22 to 28 knots' force, but unfortunately, it was accompanied by a short and rather heavy sea caused by the wind meeting the tide. Both boats labored so heavily when reaching over the few miles from Sandy Hook to the Lightship that by mutual agreement of the skippers and the Race Committee the race was postponed.

The incident is a significant commentary upon the unseaworthiness of these modern racing craft, whose scantling has been skinned down to the last ounce of weight, and whose towering rig, with its hollow spars and attenuated standing gear is poorly constituted to stand the dynamic forces which result from a squally wind and a short, snappy sea. As Sir Thomas Lipton's steam yacht, with guests aboard, steamed back inside the Hook to speak to "Shamrock IV," she passed the 23-meter "Shamrock." "There," said one of the guests, a grizzled yachtsman who has been in the game for over thirty years, "there's a boat that would have fairly reveled in such a day as this." But the 23-meter "Shamrock," as we have already recorded in this journal, was built under a rule which seeks to combine the fast racer with the comfortable cruiser. Her scantling and masting had to be built to strict specifications, and more than that, before she could enter the races she had to be given an A1 classification by Lloyd's, based upon these specifications.

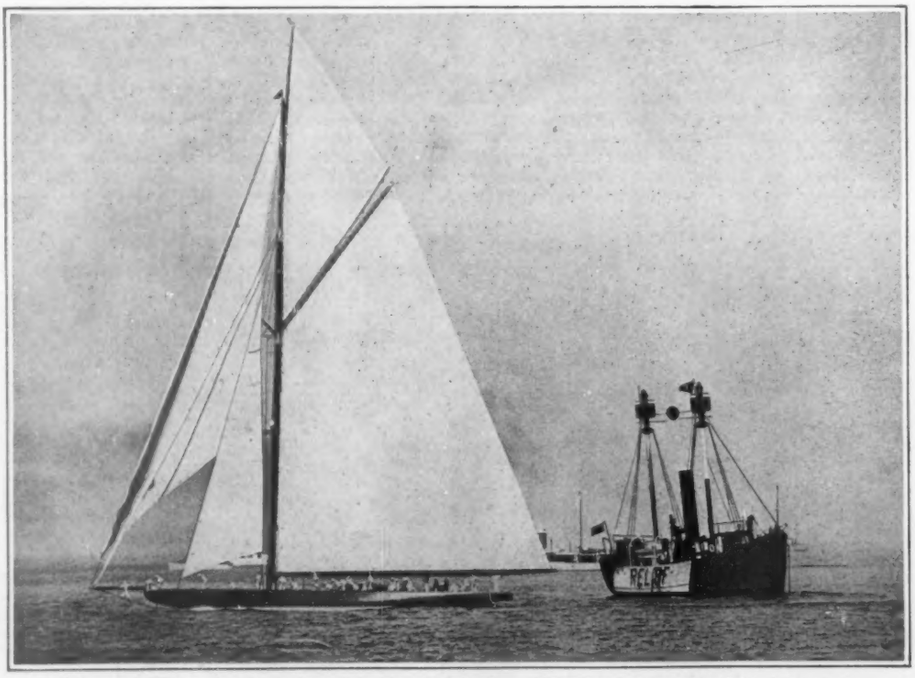
Yachting nations of all the world, realizing the then existing conditions tended to produce such boats as "Resolute" and "Shamrock," recently got together and drew up a rule which is a modification of the rule under which "Shamrock" was built. An earnest invitation was sent to the United States, asking us to join in this movement, and Mr. Burton, who sailed "Shamrock IV," came to this country to further the request. But unfortunately, as we think, the representatives of our leading yacht club refused to enter into any such association. Had we done so, any yacht of any nation would be eligible to enter the local regattas

(Continued on page 140)



"Shamrock IV" leads "Resolute" across the line in a dead heat; but "Resolute" wins by her 7 minutes 1 second time allowance

Finish of third race—30 miles windward and leeward



"Shamrock IV" passing the Ambrose lightship, with a lead over "Resolute" of 9 minutes 27 seconds actual, and 2 minutes 26 seconds corrected time

Finish of second race—30 miles triangular

When Steel Explodes—and Why

WHO ever heard of a chunk of steel exploding? None of the metallurgists in the General Electric Research Laboratory ever had until one May day this year. On that day Herman Winkler, an employe busy hardening three slugs of ordinary Sanderson carbon steel to be used as plungers in making genelite, a new self-lubricating bearing metal, drew a slug out of the electric furnace at about 750 degrees Centigrade, quenched it in a tank and then took it in his left hand. With a rasp in his right hand he was about to test the slug's hardness when someone distracted his attention. In that moment the end of his rasp tapped the flat end of the slug.

"It flew to pieces with a crack like a pistol shot," said Mr. Winkler. "One chunk went by my ear, another went straight up and the remaining two dropped into the sink. It was peculiar. My hand was merely bruised a little bit."

The only explanation advanced for the phenomenon is that the slug, which was about four and a half inches long and four in diameter, cooled a degree too quickly on the outside and the heat-expanded core exerted a surface tension so unusual that the slightest touch at that exact moment produced the violent fracture. The other two slugs from the same bar that day got what appeared to be exactly the same treatment, as have thousands of other steel slugs in times past, and not one ever responded as this one did. The photographs show there was no flaw in the metal, but the lines of core strain are obvious.

The first four fragments show the explosive break of carbon steel, quenched to too low a temperature. The fifth specimen shows carbon steel block broken by hardening strains

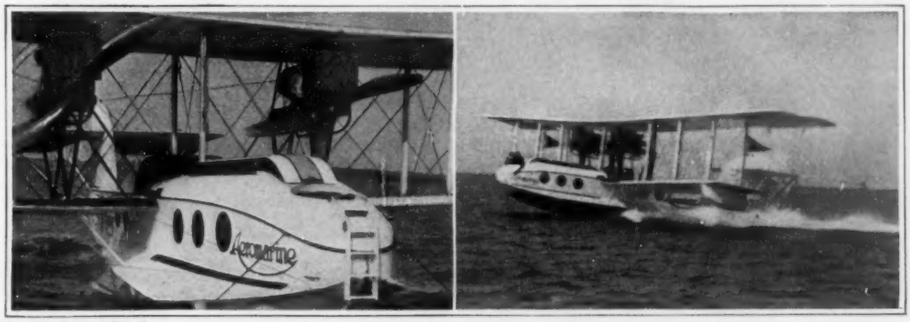
Our Latest Aerial Creations

WHATEVER may be said regarding the dumping of foreign airplanes in these United States, the fact remains that we are pretty well able to take care of our aerial needs both as regards quality and quantity. In fact all that seems necessary just now is for the Government or the public at large to give the aircraft constructors proper support in order that they may hold their equipment and personnel intact.

Two of our recent aerial creations are the huge L.W.F. plane and the sturdy Aeromarine cruiser, both of which are shown in the accompanying illustrations. These large aircraft compare most favorably with those of England and France, and are only surpassed by the all-metal giants of Germany. For that matter Germany—and we have reiterated this statement over and over again in these columns in the spirit of scientific impartiality—has a monopoly in all-metal construction for some reason which is hard to fathom.

The L.W.F. giant can be briefly described as a biplane with two fuselages and a central nacelle, driven by three Liberty engines with tractor screws. The wing spread is 105 feet. The machine has been purchased by the U. S. Army for use as a bomber.

The Aeromarine cruiser is designed to carry fourteen persons. It has a wing spread of 103 feet, weighs eight tons, and is driven by two 400-horse-power Liberty engines. The main cabin accommodates nine, while the smoking compartment seats five. The equipment, which is quite complete, includes a buffet.



Copyright, Keystone View Co.

Close-up view of the cabin and engines of the Aeromarine Cruiser, and the huge flying boat speeding along on the water prior to taking the air

How the huge L. W. F. biplane appears when in actual flight with the engines full on

Two views of the giant L. W. F. biplane, which has a wing spread of 105 feet and which is powered with three Liberty engines

Observations on Radio Transmission Phenomena

THE Bureau of Standards has secured the coöperation of the American Radio Relay League in the collection of data for a study of the nature and causes of the fading of radio signals. It has been observed by radio amateurs generally that the strength of signals received from a given transmitting station varies rapidly during very short intervals of time, this variation probably depending upon the weather and various meteorological conditions.

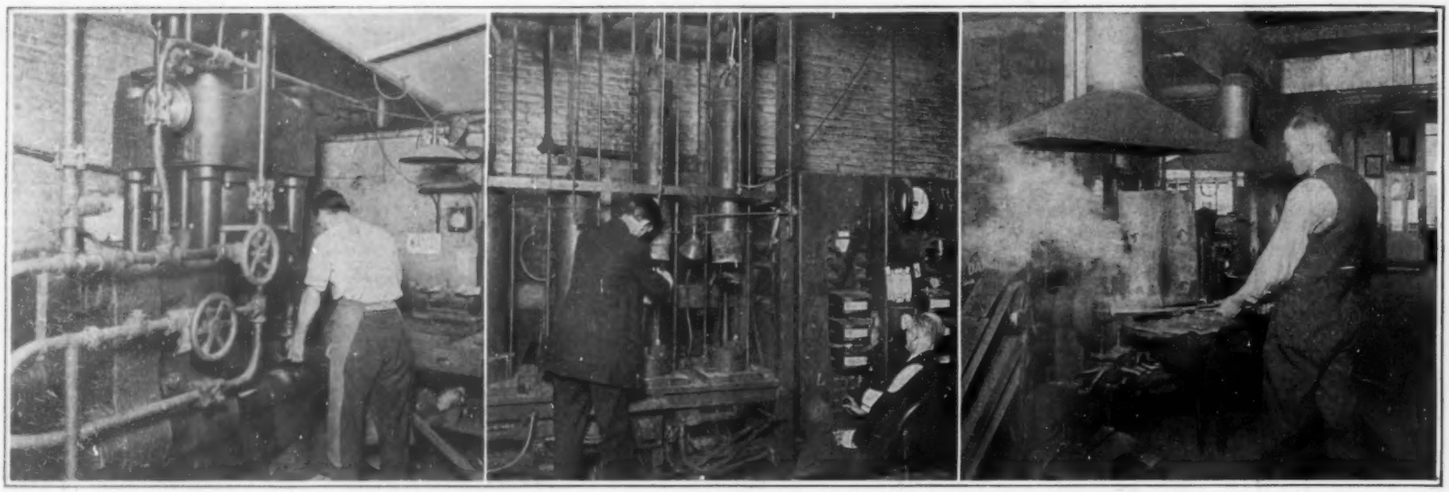
In order to secure simultaneous observation of signals, arrangements have been made for a number of well equipped amateur radio stations, including six transmitting stations and about forty receiving stations, to begin such a series of tests. The six transmitting stations will send out a broadcast message lasting about three minutes each on Tuesday, Thursday and Saturday evening, beginning just after the time signals from the Arlington Radio Station of the Navy. These stations will transmit for their different regions ten minutes apart, and three or four of them will be within the receiving range of each receiving station.

Forms have been provided by the Bureau of Standards on which the operators will record the strength of the signals which they receive, weather conditions, presence of strays or atmospheric disturbances and the general character of radio transmission at the time of each observation.

It is hoped that from this program of careful observations some valuable conclusions regarding radio transmission will be worked out. If the present plan, covering only the northeast part of the United States is successful, a more extensive program may be undertaken during the coming winter.

Mental Tests in Schools

THE National Research Council announces that the mental tests which were used with striking success in the Army during the war are to be used on a large scale in American public schools. A program of group tests has been worked out which will make it possible to conduct wholesale surveys of schools annually, or even semi-annually, so that grade classification and individual educational treatment can be adjusted with desirable frequency. Prof. R. M. Yerkes is in charge of this undertaking, and the General Education Board is furnishing financial support.



1. Pressing the tungsten powder, under 16 tons pressure, into blocks that are too crumbly to handle. 2. Putting these slugs into a hydrogen atmosphere for treatment with electric current to improve the cohesive qualities. 3. The red hot tungsten bar passing through one of the many swagers whose revolving hammers chatter on all sides of the bar to bring it to smaller compass.

rom powder that will not stick together to wire of great tensile strength

The Romance of Tungsten

How This Erstwhile Brittle Metal Was Made Available for Lamps

By George Gaulois

A CASUAL look at the filament of the incandescent lamp in your library or at the tiny spark coil contacts on your automobile brings no suggestion of the romance of science which lies back of those devices. It is the romance of tungsten, one of the heaviest of metals, a metal nearly 140 years old but which resisted the efforts of mankind to make use of it in its pure state for about 130 years.

Yet the service pure tungsten has rendered the world in the last decade since it was "conquered" is almost too great for calculation. Tungsten in its various forms reduced America's electric light bill a billion dollars a year and more than doubled the usefulness of the incandescent lamp. Ductile tungsten kept the automobile industry alive during the war. It helped make possible the Coolidge X-ray tube with tungsten targets which tremendously increased the value of the X-ray machine to mankind. With it the pliotron was built so that wireless telephony could be developed to a useful and dependable point. With it the tungar rectifier was created so that owners of automobiles could charge their cars in their own garages by simply plugging into a light socket. With it phonograph needles are being made more than 50 times as good as the steel and the fiber needles, heretofore considered the best that could be produced.

Tunsten bullets might have served in the recent war as projectiles hard enough to pierce the heaviest armor the Germans could put on their aircraft, for a few were made to prove their usefulness in that capacity, but the plan to use them was given up after a less expensive way to accomplish the result was discovered.

Before the war only a few thousand tons of tungsten ore were mined in all the world and the price of raw tungsten ranged around 90 cents a pound; but with the war came a tremendous demand for tool steel hard enough to work at high speed though red hot. Tungsten was required as an alloy to make such steel.

TUNGSTEN, at once the hardest and heaviest of metals, for a century after its discovery was brittle in its pure state and therefore unworkable. How Dr. Coolidge made it sufficiently ductile for the purposes of wire-drawing, and thereby lopped a billion dollars off the lighting bill of America alone, is the story which Mr. Gaulois puts before us here.—THE EDITOR.

The price rose steeply when the supply diminished before the sudden demand until it reached $7 or $8 a pound. The world's production in 1918 amounted to 35,800 tons. The control over the sources of it was 59 per cent American and 35 per cent British. The price and production slumped with the end of the war until today raw tungsten can be bought for a little over a dollar a pound.

Most of the adaptations for tungsten are due to a discovery made by Dr. W. D. Coolidge, a physicist in the research laboratory of the General Electric Company of Schenectady. He was the first man to find a way to work this most brittle of metals. He made it ductile and thereby hangs this tale.

For about 100 years tungsten had been known before it was put to any use whatever, even as a mere alloy. Its presence was first noticed by Scheele and Bergman in 1781. They found traces of it in a metal called scheelite and coined the name "tungsten" for it from the Swedish "tung," meaning weighty and "sten" for stone. In 1783 three Spaniards discovered tungsten in the mineral wolfram. To this day there is little tungsten taken from any other minerals. It is found in small quantities in Cumberland, England; Limoges, France; and in parts of Connecticut and North Carolina, but most of it comes from Colorado and China.

Extracted from these minerals and pulverized,

(*Continued on page 140*)

Left: Drawing tungsten down to wire one-sixth the diameter of a human hair. The thread of tungsten unwinds from spool at extreme right, passes through a lubricant, then into a gas furnace which has a diamond die, and finally on to a receiving spool. *Right:* Winding the fine tungsten wire by hand on the lamp mount

Making tungsten wire of almost invisible gage for lamps

With the exception of the legs and the tail, this potato was found as it is

When Is a Potato Worth $140?

FREAK vegetables have always been a source of much interest—and much money, too. The Chinese, for instance, pay high prices for ginseng roots which resemble the human form; indeed, these odd-shaped roots are graded according to their relative similarity, and sold to superstitious Chinese at prices ranging from very little to a good deal more than these roots can ever be worth as far as medicinal properties are concerned.

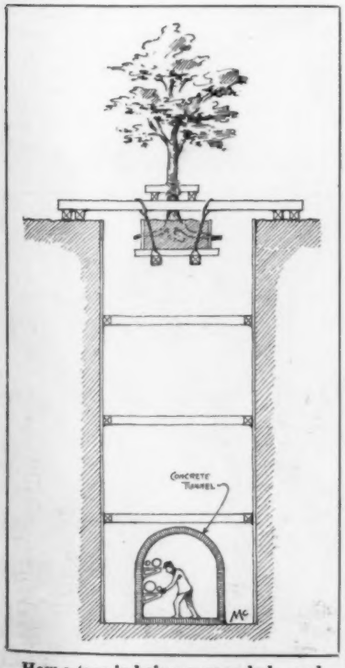
We present in the accompanying illustration a potatoe which brought $140 at a fair in Tacoma, Wash. This potatoe, with the exception of the legs and the tail, is a natural growth, yet its resemblance to a pig could not be better. It was the subject of much interest and many persons took a chance on winning it as the result of a raffle for the purpose of raising money for the boys in the army and navy.

The Worth of a Tree

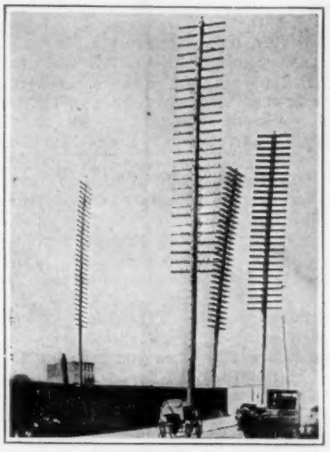
THAT the welfare of a tree is something to consider is being well illustrated on the Capitol grounds at Denver, Col. In surveying for an underground passage way to connect the State Museum with the new executive building a block distant it was found that an elm tree was in line of the proposed work.

The contractor was for cutting it down, or replanting it at least. But no, the results of replanting a tree of any size are not always satisfactory and as trees are being looked upon generally as good citizens, risks are not to be taken. So under painstaking supervision the roots were shored with long timbers, the ends of which rested on the ground at either side of the tunnel line. Under this a platform was then built, suspended basket-fashion from planks and cable spanning the space to provide adequate support.

In excavating for the passage-way a generous portion of the earth was left about the roots of the tree so as to assure their nourishment and safe-keeping. Some thirty feet below this suspended trunk the men are digging and cementing and walling the tunnel, and when it is all done the earth will be filled in underneath the platform, the timbers will be removed and life for this elm, it is hoped, will go steadily on.



How a tree is being suspended—and saved—while a tunnel is in building



Long ago New York took the wires off these poles and buried them under the streets

New York's Buried Wires

THE accompanying view is reminiscent of the early days of the telephone in New York City. Some thirty years ago it was the practice to place telephone and telegraph wires on lofty poles and cross-arms just as is now the case in rural communities and even in large cities.

With the most commendable foresight, the telegraph and telephone interests of New York City early in their career decided to place their wires underground. For this purpose special ducts and tunnels were provided under the city streets, and the unsightly poles with their maze of wires soon became a thing of the past. Today New York is a model of neatness as regards wires. Indeed, there are practically no wires to be seen in the city proper, and it is only in the outskirts of the metropolis, where the metropolitan atmosphere is more or less lost anyway, that one comes across telegraph and telephone poles.

Effect of Oils on Strength of Glues in Plywood

PLYWOOD may be used near machinery and tanks with little likelihood of being dangerously weakened by the action of oil or gasoline on the glue joints. This fact is evident from a test lately completed at the Forest Products Laboratory.

Plywood panels glued with animal, vegetable, blood albumin, and casein glues were immersed for nearly a year in engine oil and gasoline. At regular intervals specimens were removed from the liquids and tested for joint strength. All the glues weakened somewhat during the early part of the test, the animal and vegetable glues more than the casein and blood albumin glues. The total loss of strength in any case, however, was small enough to be negligible under most conditions of service. A glue shear strength of 100 to 125 pounds per square inch is considered sufficient for practically any purpose for which plywood is used. Only in two or three instances did the strength of the casein and blood albumin glues fall below 150 pounds per square inch. Engine oil, castor oil, and gasoline seemed to have practically the same effect on the glue joints.

Wireless Music and News for the Roller Chair Passenger

ASBURY PARK, N. J., has the unique distinction of being the first city in which boardwalk roller chairs have been equipped with wireless telephone and telegraph receiving apparatus so that the passengers are enabled to hear talking and musical concerts from distant stations while the chair rolls merrily along.

W. Harold Warren, who some time ago demonstrated that it is possible to receive wireless telephone and telegraph signals within a steel and concrete bank vault with both inner and outer doors closed and with no external connections to the instruments, is responsible for this new innovation that has already proven so popular at this charming seaside resort.

A small flat "loop" replaces the ordinary aerial and ground connections, and the whole apparatus is so compact that three persons can sit with it comfortably in the chair. The most interesting part of the installation is the fact that the vibrations of the roller chair in motion have no effect whatever on the reception of the signals.

The directional effect of the "loop" is most pronounced, the strongest signals being received when the vertical plane of the "loop" is in the direction of the transmitting station. Signals from stations over 200 miles distant are received with the apparatus.

These hob-nailed shoes have been worn for 90 days with hardly a sign of wear

Why Not Hob-Nailed Shoes?

THE Bureau of Standards has been conducting a series of interesting tests on footwear in view of the high price of shoes and leather. One particular test took the form of wearing a pair of hob-nailed shoes for several months in order to determine to just what extent the nails take up the usual wear of the leather. The pair of shoes shown in the accompanying illustration was subjected to ninety days' actual wear by means of a machine devised for such tests. As will be noted the leather is hardly worn, while the hob-nails are practically worn down.

Using Water for Blasting Rock

A WRITER in a German technical paper describes a hydraulic device for blowing up rocks, and, in particular for demolishing bridge piles and

The loop antenna enables roller chair passengers to listen to music and news reports

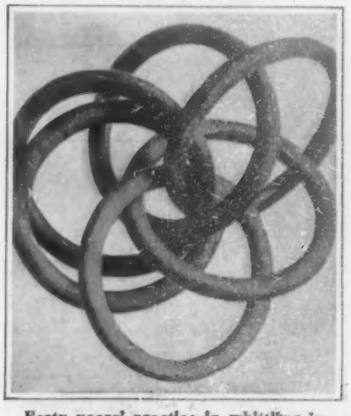
ferro-concrete foundations. It is based on the principle of the hydraulic press; enormous pressures are set up within the rock, which eventually bursts. The pressure is transmitted by a pipe-line to a cylinder 85 millimeters in diameter in which eight pistons may be successively displaced telescopically. The cylinder is inserted into a hole, drilled by an electric drill in the rock to be blown up. The pistons bury themselves in the rock one after another and blow up the rock. The holes take 10 to 15 minutes to drill (they are about 2.5 centimeters deep), and in 5 minutes after that the rock is shattered. It is said that this device has proved successful in mines and quarries where the use of explosives would be dangerous.

Try This Whittling Job on Your Pen-Knife

A MASTERPIECE of whittling has just been completed by A. T. Cook of Hyde Park, N. Y. The rings shown in the accompanying illustration are cut from a solid piece of wood and are said to form the most complex and difficult piece of whittling ever accomplished with a jack-knife.

But the aforementioned claim is a difficult one to defend; there have been many remarkable pieces of whittling shown and described in these columns during the seventy-five years this journal has been issued.

The rings here shown are so whittled that each one passes through all the rest, thus complicating the work of making them. Mr. Cook, so we are told, has been whittling more or less for forty years, and considers this piece of work his best achievement.



Forty years' practice in whittling is represented in these rings cut from a single piece

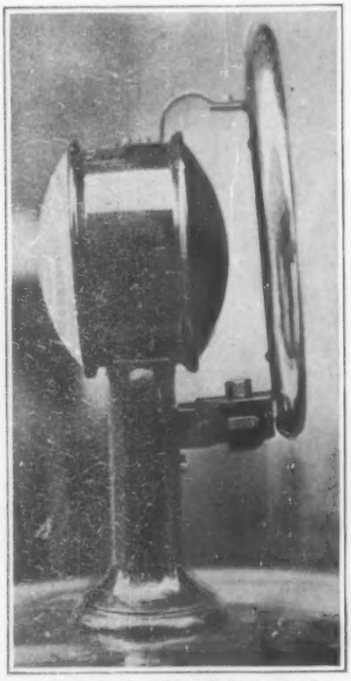
Inventions New and Interesting

A Department Devoted to Pioneer Work in the Arts

A charge of sawdust burns twelve hours in a stove invented by an Englishman

A Sawdust Stove for Coal-less Europe

THE coal shortage which many of the European countries face this coming winter has not failed to spur inventors in the direction of new fuels and stoves. One of the most recent attempts to solve the heating question is presented in the accompanying illustration, and consists of a special stove which burns sawdust. The stove consists of a cylindrical casing provided with suitable holes for draft purposes, and a container which is packed with sawdust as shown. Once ignited, the tightly packed sawdust is said to burn slowly and evenly, giving considerable heat. A single charge of sawdust burns twelve hours. The action, we are told, is very much the same as coal as far as smooth burning and the intensity of heat are concerned.



A mirror and parking light in one for the motor car

Difficulties of the German Paper Industry

ACCORDING to a recent issue of *Kölner Zeitung*, the German paper industry is seriously handicapped by the scarcity and increased prices of raw materials. This is particularly true of old paper and rags, which are extremely difficult to obtain, and have reached a price which appears unjustified. It is believed that old paper and rag dealers have been holding their supplies to drive prices up. The demand is very great and constantly increasing in spite of the fact that consumers believe present prices cannot continue. The cellulose plants in eastern Germany, which have been forced to suspend production for some weeks owing to the shortage of coal, have recently resumed operations, and it is hoped that renewed deliveries of cellulose will help to drive down the prices of old paper and rags. Straw, which is used in large quantities in the German paper industry, is now quoted at 55 to 60 marks per 100 kilos, but this price is expected to fall in the near future. It is hoped that this will also have an effect on the prices of other raw materials. Wages in the industry have risen over 100 per cent since December, and the cost of coal, chemicals, dyes, and other raw materials has risen in like manner. Manufacturers have therefore been forced to increase the price of paper to a point where the demand is seriously affected. Unless the cost of raw materials falls very soon the industry will undoubtedly suffer.

A Mirror by Day—A Light by Night

IN order to comply with the laws of many States which require the car owner to equip his car with a mirror on the left front mudguard and to keep lights burning when his car is parked at night, an ingenious inventor has recently introduced a combination mirror and parking light shown in the accompanying illustration.

During daylight the mirror is held in the position shown in the illustration, always ready for use. Its position on the mudguard gives it an ideal field of vision. At night when the car is to be parked or left standing the mirror is dropped down to the horizontal position and the light is flashed on. The front lens of the lamp is white, while the rear one is red. In this manner the automobile shows a white light in front and a red light toward the rear, in compliance with the State laws. Incidentally—and this is a very powerful argument in favor of this new device—there is a saving of considerable current when operating this light in place of the usual equipment. Indeed, the inventor claims that the usual lighting—two headlights and the tail light—requires several times the current used by his device for accomplishing the same purpose.

What Did the Dentist Put in Your Mouth?

LIKE battering the head of a rivet with constant tapping until the tiny bit of metal is flattened, similarly the point of your tooth (for instance, in chewing beefsteak) from an opposite jaw applies a load of several thousand pounds to the square inch on the amalgam or teeth fillings. The intensity of the pounding is caused by the restricted area in which the point of the tooth operates.

What is the relative wear on your teeth fillings, what is the crushing strength exerted upon amalgam, and what influence has ice water and hot foods on the artificial patchings in the cavity of your tooth? These questions are not insignificant when a visit to the dentist is convincing proof that dental material figures in the budget of H. C. L. So the U. S. Bureau of Standards devised a special apparatus for testing the wear and tear on fillings when subjected to constant pressure. Not that there should be any release of the tension placed on the amalgam in the mouth—as this would result in bad digestion—but the experiments sought to determine the durability of the material entering into the construction of teeth fillings.

It was discovered that by rapid-fire eating—when the crushing load is constant—the pressure exerted on the teeth fillings is in excess of 22,000 pounds to the square inch. This rate was indicated when the amalgam was crushed quickly, within three minutes—the dental material had set for 48 hours. However, by applying a constant impact of 3,200 pounds, one-tenth of the former crushing load, it was possible to crush some of these same amalgams in 20 hours.

With the foregoing facts established, comparative flow tests were made. Within two hours after packing, a load of 3,200 pounds to the square inch was applied to a specimen of fillings 4 millimeters in diameter and 8 millimeters long. The new type of apparatus used, specially designed for the purpose by the Bureau of Standards, consisted of a micrometer with a weight pan attached at the top of the upright rod or plunger. The two ends of the specimen of fillings were cut at right angles to the axis and inserted in the jaws of the micrometer. As the amalgam is subjected to pressure by weight applied at the top of the rod the indicator moves around the dial. The difference of readings reflects the amount of flow. An air cushion plunger in the micrometer obviates possible injury to the instrument if the fillings fracture abruptly.

Two hours after amalgamation and packing, the specimen was subjected to a pressure of 3,200 pounds to the square inch, being compressed 4 per cent in thirty minutes. Most amalgams will withstand this test well at one hour and a few at 30 minutes after packing. It was concluded that the qualities of failure seem to be inherent in some dental material, these failures betraying their weaknesses as readily after 48 hours as after 30 minutes. The chemical composition of one's teeth fillings vary from 45 to 69 per cent silver and from 0 to 5 per cent zinc, copper and tin making up the balance.

Samples of fillings showed irregular behavior when subjected to a temperature of 80 degrees Centigrade, the conclusion being that such temperature may exercise injury to the amalgam or change its physical properties. Tests with ice water at a temperature as low as 5 degrees Centigrade and with hot foods at temperature as high as 60 degrees Centigrade indicated no excessive pain on adjoining vital teeth. Excessive percentage of copper in teeth fillings will produce discoloration.

When the vanity bag is opened the Jack-in-the-Box shoe cleaner is ready for use

A Jack-in-the-Box Shoe Cleaner for the Vanity Bag

THE latest addition to milady's vanity case is the Jack-in-the-Box shoe cleaner, shown in use in the accompanying illustration. A strong spring is conveniently camouflaged in the dainty vanity case or bag so that normally there is nothing to indicate that the wearer has conspired to get along without the ubiquitous shoeblack. However, upon opening the compartment containing the Jack-in-the-Box shoe cleaner, the spring jumps out with the pad at the free end. The shoe cleaner can then be used in the manner shown for dusting and cleaning the shoes, after which the spring is pushed back into the vanity bag.

A micrometer arrangement whereby teeth fillings can be tested

Recently Patented Inventions

Brief Descriptions of Recently Patented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.

Pertaining to Aeronautics

DIRIGIBLE AIRSHIPS.—J. JANDA, c/o U. S. Navy Recruiting Station, Tulsa, Okla. Among the objects of the invention is to provide a dirigible airship having a plurality of independent or separable gas bags or equivalent buoyant receptacles so coupled together during normal operation as to operate as a unitary ship, but which in the event of serious damage to one of the bags it may be separated from the remaining bags, permitting the latter to continue on their course for further operation. A further object is to provide a large aircraft for the convenience of a number of aeroplanes and for the despatch of such planes from the parent ship.

PARACHUTE.—J. W. TAYLOR, 12310 Miles Ave., Cleveland, Ohio. The invention has for its object to provide a device especially adapted for supporting an illuminant packed in a suitable container, and in the form of a projectile adapted to be fired from a gun and exploded at a predetermined point, to release the illuminant and the parachute wherein the parachute is so arranged as to relieve stresses imposed thereupon in retarding the velocity of the illuminant at the high velocity at first obtaining.

Electrical Devices

EXTENSION BASE LAMP BULB.—P. P. HEIN, c/o Bory, 444 E. 70th St., New York, N. Y. Among the objects of the invention is to provide an electric lamp bulb having an adjustable or extensible base whereby when the base is locked in the reflector socket the filament or bulb portion proper may be adjusted axially toward or from the socket anchorage for focusing purposes. The device is adapted to be fitted for use in connection with any ordinary reflector, the socket of which has a fixed position with respect to the reflector.

Of Interest to Farmers

HAY COCKING MACHINE.—J. A. FRANCE, Sault Ste Marie, Mich. The object of the invention is to provide an arrangement of hay cocking machines wherein hay is gathered up and deposited on a platform for discharging after having been arranged in a cock of the desired size. A further object is the provision of a machine for gathering hay into hay cocks formed with the lifting mechanism having supporting ropes normally sagging between adjacent cleats for receiving the hay from a hay rake or gatherer and discharging the same at a given point.

GRAIN STORAGE BIN.—L. H. DICKELMAN, Forest, Ohio. The invention relates to storage bins more particularly for storing rice. An object is to provide a portable grain bin which is composed largely of sheet metal, having means for automatically ventilating the rice or grain thereby preventing the overheating of the same and obviating the necessity of "turning over" the grain or handling it otherwise to prevent overheating, at the same time preventing the admission of sufficient air containing moisture, which might be detrimental to the grain.

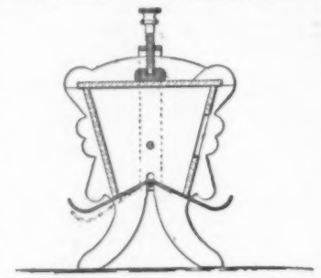
Of General Interest

DISPLAY CARTON.—R. VAN IDERSTINE, 286 Park Ave., Newark, N. J. Among the objects of the invention is to provide a box construction comprising a plurality of interfitting or telescoping parts, which will at all times provide a connection so as to prevent the possibility of the parts becoming separated or lost, but still to permit free relative movement between the parts and to permit the parts to be readily arranged in a position most effective for purposes of display.

PRINTED BOOK.—H. W. HAIGHT, Cranford, N. J. The object of the invention is to provide a printed book or block for school purposes, more especially designed to restrain a scholar from looking ahead of the page being used. In order to produce the desired result the leaves of the book have applied thereto a fastening means such as glue or other adhesive substance to fasten the leaves along the top, bottom and sides, the fastening means having an interrupted portion to allow the insertion of a paper knife or other tool between the adjacent leaves.

COMBINED HANGER AND FRAME PROTECTOR.—J. GREENWALD, 940 3rd Ave., New York, N. Y. This invention relates particularly to picture frames. The object is to provide a corner piece which cannot be seen from the front, but which will protect and reinforce the frame in such a manner as to prevent separation while at the same time presenting a construction wherein a suspending cord may be readily secured thereto.

DELIVERING APPARATUS.—M. BONO, 60 E. Houston St., New York, N. Y. The invention relates to a delivering apparatus, and more particularly to a sanitary receptacle especially adapted for delivering toothpicks. It



A TRANSVERSE SECTIONAL VIEW, PARTLY BROKEN AWAY

is one of the primary objects to so construct the device that its delivering mechanism may be adjusted to operate to deliver one or more articles as desired. The receptacle cover is retained in place by the adjusting means of the delivering mechanism.

CARD FILE.—W. L. DINSMOOR, 925 Geary St., San Francisco, Cal. More particularly this invention has in view to produce a file employing index cards on spindles and so arranged as to provide a convenient means for keeping a file of business cards of patients or clients of professional men; however the device is adapted for other purposes of filing, or for holding calendar cards.

DOLL.—M. J. DUFF, 75 Hadden St., Bridgeport, Conn. The primary object of the invention is to provide a figure toy and construct the same in such manner that any one of a plurality of different expressions for the face may be obtained. A further object is to construct the figure entirely of cardboard, paper or the like, thus greatly decreasing its cost of manufacture.

PROCESS FOR MAKING NON-INTOXICATING BEVERAGES.—W. WILHELMY, Sr., 139 N. Clark St., Chicago, Ill. This invention relates to the manufacture of non-intoxicating beverages with nearly the usual equipment of a modern brewery, without the use of special apparatus. The process consists of adding yeast to thin wort containing extract of hops at a moderately high fermenting temperature, allowing to stand for a predetermined period, reducing to a cooling temperature, and allowing to stand at such temperature for a specified time, adding a body giving substance and finally carbonating the beverage.

CHAIR SWING.—J. W. SPARKS, Clear Lake, Iowa. The invention has for its object to provide a chair swing which will be comfortable for a child, which will prevent the child from slipping or falling out, and which can

A VIEW IN SIDE ELEVATION PARTLY IN SECTION

be collapsed and packed in a small space when not desired for use. A further object is to provide a swing of the character stated, which can be adjusted to the height desired, and which will be strong and durable.

CLASP.—S. SCHRANTZ, 5938 Niverna Ave., St. Louis, Mo. This invention relates particularly to clasps for spectacle cases. An important object of the invention is to provide a clasp for spectacle cases which will be so constructed and disposed on the spectacle case as to be highly effective to retain the case in the desired position and at the same time will not present a projection likely to cause annoyance or discomfort to the user.

PRINTING FRAME.—D. F. YOUNKIN, 800 Coleman Ave., Johnstown, Pa. This invention has for its object to provide a frame adapted for all classes of printing, but especially for printing from tracings, for instance, of greater length than the frame, the frame being so arranged that the tracing may be drawn through the same to permit every portion to be printed from, and wherein a form of lock for the frame is provided.

SWAGGER STICK.—J. M. CALLAHAN, 17 "S" St., N. W., Washington, D. C. The invention relates generally to swagger sticks and more particularly to a stick comprising a handle having an engaging implement at one end in the form of a hook for the purpose of permitting of practical use of a device of this character in many instances of ordinary every day life, for instance, engaging the hand strap rail, or seat rail of a street car or other objects encountered, and in the nature of disease spreaders.

APPARATUS FOR FORMING GUN BARRELS.—W. F. COLE, 901 Amicable Bldg., Waco, Texas. The invention relates particularly to the manufacture of gun barrels having smooth bores of elliptical shape, twisted uniformly and adapted to replace gun barrels having the usual internal rifling. An object is to provide an apparatus whereby a cylindrical tube may be slightly flattened along a uniform helical line for either its entire length or the greater portion of its length.

DRIP DEVICE.—W. H. GROVER, Bay Shore, N. Y. The invention has for its object to provide a device more particularly for dripping fruit and the like in the manufacture of jelly. A further object is to provide a device which will be entirely sanitary, which will protect the drip from contact with dust, dirt or insects, which can be conveniently located at any point desired, and which can be folded and packed in a small space when not in use.

MATCH LIGHTER.—E. J. FISHER, 109 Whitestone Ave., Flushing, L. I., N. Y. This invention aims to provide a device whereby matches other than safety matches may be readily lighted. The device is especially intended for use in hotels and stores; it is extremely simple in form, economical in manufacture, can be placed anywhere and be an ornamentation, and can be utilized in the capacity of an advertising medium.

Hardware and Tools

SCISSORS.—C. R. STORZ, 980 Greer Ave., Brooklyn, N. Y. The invention relates to scissors generally, but having particular advantages when embodied in surgical scissors. The object is to provide a scissors with removable cutting blades immovable in position, and providing for the convenient placing and removing of the blades. Among the advantages are that the blades can be replaced by new ones for approximately the cost of resharpening, also material may be used for the blades having the highest cutting quality and which for technical reasons cannot be used for the body.

FAUCET.—A. LANDGREBE, 1724 Barnes Ave., Van Nest, Bronx, N. Y. The invention has particular reference to faucets adapted to close automatically. Among the objects is to provide a faucet of a construction adapted to be manufactured mainly of glass or other analogous sanitary material. A further object is to provide a faucet comprising a valve seat, a valve or its equivalent, and means adapted to be operated either in front or above the delivery nozzle to manipulate the valve.

VISE.—L. H. DALLARD, 110 Convent Ave., New York, N. Y. The invention relates more particularly to vises of the quick adjusting type. The object is to provide a mechanism by means of which the jaws may be readily opened to any desired adjustment without the necessity of rotating the driving screw, the invention being provided with a driving screw which is disengaged from the operating mechanism.

NUT LOCK.—B. G. PATTERSON, 1210 W. 28th St., Oklahoma City, Okla. An object of the invention is to provide a simple one-piece nut which can be manufactured at low cost, which shall be substantially the same dimensions as standard commercial nuts and which shall be capable of being locked in position upon a bolt by screwing it tightly against a load surface. Another object is to provide a self-locking nut that can be quickly applied and which can be repeatedly used without injury to either the nut or the bolt upon which it is placed.

Machines and Mechanical Devices

CENTRIFUGAL PUMP.—R. N. TRANE, La Crosse, Wis. The invention has for an object the provision of a construction wherein the water is acted on at two stages before it is discharged from the pump. Another object is to provide a construction wherein the impeller of the pump will act on the water or other liquid in the proper manner when same is at a low speed, and will later act on the same water when at high speed for increasing in a regular manner the speed.

EXPRESSION MECHANISM FOR MECHANICAL PIANOS.—C. CONTAL and E. REQUILLART, 39 Rue Lemours, Paris, France. An object of the invention is to provide expression producing mechanism so fitted as to allow a performer to regulate at will the intensity of the different notes which may be played simultaneously both in the treble and bass so that he may at any moment decrease or increase the sound of either a single note or a group of single notes comprised in a given interval or notes distributed on the whole length of the keyboard.

TOMATO AND FRUIT SORTER AND DISTRIBUTER.—T. J. PETERS, Peters, Fla. The object of this invention is to provide means which will convey tomatoes and fruit without injury to a sorter where they will be turned over as they are conveyed to a sizer to assist in the removal of off-grade and ripe fruit; the size of which is adjustable, serving to separate the tomatoes and fruit according to size as they move to a distributer which directs the tomatoes and fruit to the packers.

FEEDING DEVICE FOR PRODUCING SPIRAL STITCHES.—H. ADLER, c/o A. & T. Mach. Co., 36 E. 4th St., New York, N. Y. The invention has for its object to provide a simple means for automatically moving a work holder transversely as it is advanced by a sewing machine feeder through the sewing process. Another object is to provide means for quickly adjusting the work holder transversely relative to the sewing machine needle, and for actuating the stopping means for the machine when the member moves transversely a predetermined distance.

CUTTER CLEARANCE GAGE.—W. DALLAS, 1120 So. 52nd St., Philadelphia, Pa. The invention relates to a precision measurement gage for indicating the proper clearance angle to be ground upon the cutting tooth of a milling cutter tool. An object is to provide a simple form of cutter clearance gage which may be applied to the tooth of the milling cutter for testing the ground angle of the tooth without removing the cutter from the mandrel of a grinding machine.

FRUIT GRADER.—E. S. LATNER, Acme, Mich. The invention relates more particularly to a machine for grading apples into given sizes. The general object is to provide a machine to facilitate the process of packing apples according to size and to provide a simple structure that will handle the fruit without bruising. The object is attained by use of a grading frame over which the fruit may roll, the frame being mounted to be oscillated and arranged for manual operation.

ROAD MACHINE.—J. H. MCLEOD, 1252 Fillmore St., Topeka, Kan. This invention has for its object to provide a machine which will work the road whether wet or dry, crushing lumps when dry and squeezing the water out of the ruts and packing the soil from the high places to the low places when wet, and afterward finishing and smoothing the road, wherein the crushing and packing is brought about by a roller having spiral ribs which work the soil as it moves thereover.

SAVINGS CLOCK.—A. G. P. WINGAARD, No. 3 Norrevold, Copenhagen, Denmark. This invention relates to a clock connected with a savings box, and arranged in such manner that the clock stops after the expiration of a fixed time, unless a coin is introduced into the coin chute. To remind the owner that time for inserting another coin has come, means is provided so that the dial, some time before the clock stops, is hidden with an inscribed cover notifying the owner to that effect.

(Continued on page 136)

Lower Cost of Machining and Assembling Results From Change to Machine Made Castings

FIG. 1. In drawing the pattern by hand the least quiver plays havoc.

THE fundamental weakness in the making of moulds by hand is a normal human weakness.

Immediately upon completing heavy physical labor, the moulder must attempt operations which require 100% muscular control. Drawing the pattern by hand (Fig. 1) and patching the mould by hand demand a degree of delicate muscular accuracy properly comparable to the requirements of an etcher or a sculptor. Even the most skillful handwork at this stage varies sufficiently to leave a long trail of later expense in added cost for laying out, removing extra stock and often the scrapping of castings half-machined.

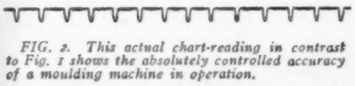


FIG. 2. This actual chart-reading in contrast to Fig. 1 shows the absolutely controlled accuracy of a moulding machine in operation.

Contrast the familiar inaccuracies of hand-moulds with the graph (Fig. 2) of the operation of a power-operated moulding machine. Although foundries, in general, may give to the casual observer an appearance of rough-and-tumble freedom, nevertheless because it is a basic process, crude, faulty foundry work is bitterly expensive later. Hence this test is employed by careful manufacturers of moulding machines, because accuracy equal to that of a Corliss engine or any fine machine-tool is an essential necessity.

The modern moulding machine is not only built to the uniformity of action shown by the graph but it is constructed to maintain throughout its life an accuracy within .0005 inch variation per inch of pattern draw. This it maintains in spite of showers of sand and dirt and a pounding of 6500 blows per day which are required to pack the sand.

In practice, what is the result of this accuracy?

The result is well illustrated in Fig. 4 which shows unretouched photographs of the same casting as produced by skilled hand work and as made from machine-made moulds. Even to the eye the hand-made casting at the left is clearly not true to shape. Necessarily uneven hand-ramming has allowed the sand to bulge in spots under gas-pressure and the resulting hills and hollows have not disappeared in the casting in spite of painstaking slicking and patching of the mould.

FIG. 3. A moulding machine in action—2/3 of the machine lies below the foundry floor. The machine, by jolting, first rams the sand around the pattern. Then flask, sand and pattern are "rolled over" until the pattern can be raised mechanically by vertical draw from the sand.

On the other hand, for the machine-made casting at the right, the sand was rammed to uniform density throughout and the pattern, when withdrawn by mechanical means, came away clean, requiring no slicking to smooth the surface of the mould and destroy the even porosity of sand. This casting can be exactly reproduced hour after hour, day after day, without any variation great enough to be detected by the camera.

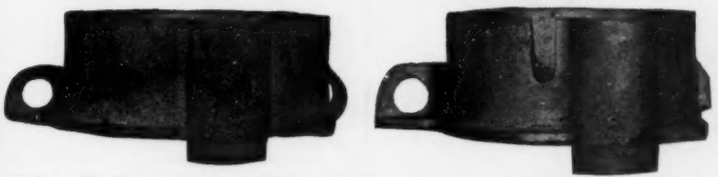


FIG. 4. The "reason why" is graphically presented in this comparison by camera of a hand-made casting on the left and a machine-made casting on the right.

Fig. 5 shows the second result of machine-moulding. An average of comparative costs furnished by scores of machine-shops which had previously operated on hand-made castings shows this surprising difference before and after the adoption of machine-made castings. This saving is reported as due primarily to four factors—

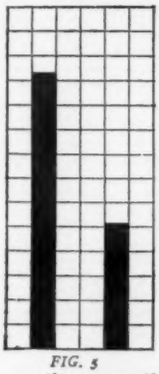


FIG. 5

1. Less layout work before machining because each machine-made casting is exactly like each other casting from the same pattern.
2. Less stock to be cut away on machines because of closer limits maintainable under machine-moulding.
3. Fewer castings found defective after receiving partial machining.
4. More adequate and regular supply of castings from foundry.

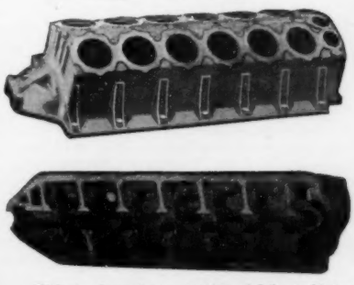


FIG. 6. Quantity production of Liberty Motors would have been close to impossible if machine moulding had not produced thousands of uniform castings of this quality.

In machine-shop practice certain very striking achievements have been made possible largely by the superior production-qualities of machine-made castings.

In our automotive industries lacking the advantage of foreign low-priced machine operators, rapid expansion would have probably been impossible had not the machine-made casting permitted standardization of machining operations and hence, wholesale economies. Without these economies few families could yet afford the initial cost of a car.

Shops which, during the war, operated on hand-made castings for the 12-cylinder liberty engine, and later on machine-made castings, can furnish some striking testimony as to the increased speed in handling the latter through machining and assembling.

It is largely true that in all plants where large scale production is produced by the aid of standardized operations, the machine-made casting is specified throughout. Here and there, however, still remain a few first-rank concerns which have not yet recognized the savings thus attainable and are puzzled by the fact that smaller competitors hold their own with them in cost of production. The advantage can usually be traced to the machine-made casting in the smaller plant.

FIG. 7. A 6-cylinder en bloc automobile engine casting is practically impossible except by machine-casting.

The factory superintendent who has assumed that the modern moulding-machine is of interest solely to the foundryman as a means of increasing output and reducing costs will discover on even the briefest personal investigation that the subject holds for him the opportunity for equal or even greater savings. To neglect to investigate the machine-made casting is to make his competitor's path easier.

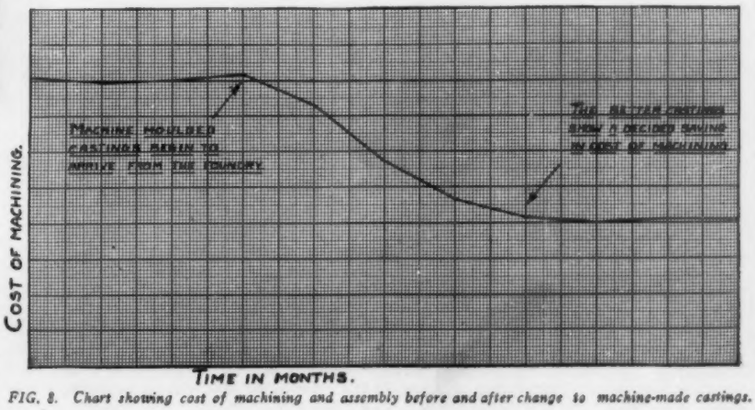


FIG. 8. Chart showing cost of machining and assembly before and after change to machine-made castings.

RECENTLY PATENTED INVENTIONS

(*Continued from page 134*)

Medical Devices

SURGICAL APPLIANCE.—L. O. ROBERTS, 146½ Kellingsworth Ave., Portland, Ore. The invention has for its object to provide an appliance of the character specified especially adapted for tying knots in ligatures in cavities

A PERSPECTIVE VIEW OF THE APPLIANCE IN USE

where it is difficult or impossible to reach with the hands. The device may be used in any cavity where it is difficult to insert the hands. In tying the knots the hermostatic forceps will be held by an assistant.

REMOVABLE BRIDGE FOR DENTAL WORK.—A. S. STONE, 133 Hegeman Ave., Brooklyn, N. Y. The invention relates to dentistry. An object is to provide a means for restoring teeth within a person's mouth and to provide a form of removable bridge work which may be fitted to sound teeth of a patient's mouth and support an artificial tooth so as to adequately fill a space left by the loss of a natural tooth, and may be removed for the purpose of cleansing the artificial members.

DENTAL APPLIANCE.—D. W. BARROW, 1216 Jas Bldg., Chattanooga, Tenn. This invention has for its object to provide an appliance intended to replace the wax bite used by dentists in obtaining occlusion for artificial teeth, which will permit true occlusion to be obtained, taking account both of the direct movement of the jaws toward each other and of the gliding movement of the lower jaw with respect to the upper.

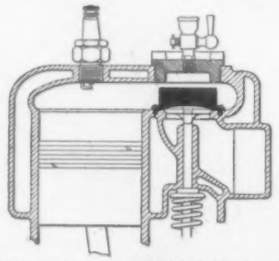
Musical Devices

PLAYER PIANO CONTROL APPARATUS.—M. S. HOWARD, Interstate Power Co., Waukon, Iowa. The object of the invention is to provide for the employment of governors for controlling the degree of vacuum attained in the pneumatics. A further object is to provide a method of regulating the action of these governors, and to provide a method of applying the system of control to the action of the striking pneumatics of a player piano.

BANJO.—R. T. CARLUCCI, 87 Ferry St., Jersey City, N. J. The invention relates to banjos, mandolins, guitars, ukuleles, drums and similar instruments having a membrane. The object is to provide means whereby the owner of such instruments is enabled to readily detach a cracked, split or otherwise injured membrane and its mounting and forward the same to a manufacturer for replacing such membrane by a new one, and when received by the owner to allow the latter to reassemble the parts without the aind of a skilled instrument maker.

Prime Movers and Their Accessories

CARBURETING SCREEN FOR INTAKE VALVES.—F. W. LAPHAM, 5036 W. 22nd Place, Cicero, Ill. This invention relates to screens for intake valves of internal combustion engines. An object is to provide a hood and means for clamping the same in place over the intake valve of an internal combustion engine, the hood being made of wire mesh, the



VERTICAL SECTION OF ENGINE SHOWING INVENTION APPLIED

structure being such that it will become heated during the use of the engine and will thereby distribute the heat to the incoming fuel so as to gasify the fuel even though the same may be of the more or less heavier kind as, for instance, kerosene.

VALVE GRINDER.—W. L. DINSMOOR, 925 Geary St., San Francisco, Cal. This invention relates particularly to valve grinders adapted for grinding valves of internal combustion engines. An object is to provide a grinding tool having means to engage the valve and vibrate the same back and forth on its seat for effective grinding and adapted also to be given a movement to optionally shift the valve to vary its position on its seat during the grinding operation, the shifting of the valve on its seat being necessary for true grinding.

Railways and Their Accessories

AUTOMATIC TRAIN STOP.—F. J. MCAVOY, 496 Clinton Ave., Newark, N. J. This invention has particular reference to means for automatically controlling the running of trains in connection with the usual Westinghouse air-brake equipment. Among the objects is to provide obstacle mechanism associated with one of the rails of the track and including a vertically movable plunger adapted normally, when the track is clear, to be substantially flush with the rail over which the wheels pass, but when the block is occupied, or the signal mechanism set at danger, will project upwardly above the surface of the rail subject to being depressed by each wheel rolling on the rail.

LOCOMOTIVE CRANE SANDER.—T. H. COCHRANE, 168 Wilkinson St., Jersey City, N. J. An object of the invention is to provide a track sander device which is readily attachable to a locomotive crane of present day use. It is a purpose to provide a design of sanding device which will adequately funciton on a locomotive crane to the same effect and for the same purpose as the sanding device now applied to ordinary locomotives.

GRAIN DOOR.—N. SMITHBACK and W. H. MEIER, 17 W. Main St., Madison, Wis. The invention relates to grain doors generally and more particularly to grain doors which swing horizontally and are adapted especially for use with grain cars or the like. An object is to provide a door of this type which is leak-tight in closed position, with an outwardly swinging section and inwardly swinging sections, the inwardly swinging sections being positively prevented from swinging outwardly beyond the closed position of the door.

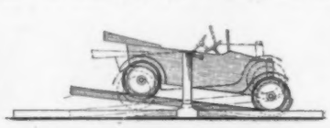
CONCRETE RAIL AND TRACK.—W. J. PLATTEN, 218 Oakland Ave., Green Bay, Wis. An object of the invention is to provide a concrete track which is stronger, more permanent and cheaper to maintain than the ordinary steel rail and wooden tie track in common use. A further object is to provide a rail and track construction which will prevent the usual sagging of the rail, in which an economy is effected in the use of steel, and in which the rail is held to the base by means of clamps which are adjustable, and which lock the rail in position, positively held from spreading apart.

Pertaining to Recreation

AMUSEMENT APPARATUS. — E. S. DOUGHTY, 417 4th St., Red Wing, Minn. The invention relates to a trackway comprising a pair of side plates and a series of treads connected with the side plates, means for supporting the trackway in elevated position, which may be varied to suit conditions, mechanism for permitting the trackway to be set up where desired, and taken down and folded for permitting of storage or transportation.

Pertaining to Vehicles

AUTOMOBILE JACK.—W. H. BUTTERS, 715 Center St., Calgary, Alberta, Canada. The object of this invention is to provide a jack on to which an automobile can be easily run and



A SIDE ELEVATION OF THE DEVICE

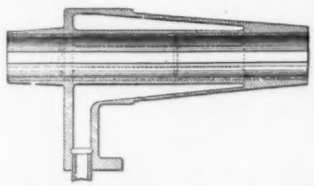
can be elevated or tilted to any desired angle and held in this position as long as desired. A further object is to provide a construction of carrier and means for operating the same to elevate and lower the automobile.

AXLE RECONSTRUCTION.—J. R. FLEMING, 801 Monroe Ave., Scranton, Pa. Among the principal objects which the invention has in view are, to avoid waste of partially worn axles, to renew service conditions in journals for wheels and similar members, to avoid loss of time in repair on car construction, and to add to the construction without weakening the part added to.

CART.—J. HINTZ, 2726 N. Lawndale Ave., Chicago, Ill. An object of the invention is to provide a small cart or wagon which has a rocking chair seat, and which may be propelled by the occupant of the chair in rocking back and forth. A further object is to provide a novel form of cart or car which is simple in construction and relatively cheap to manufacture.

VALVE.—G. W. THOMPSON, Cheboygan, Mich. This invention has for its object to provide a valve adapted to be interposed in the fuel supply line of a motor vehicle, and in the oil line for controlling the flow of the fuel to the carburetor and having means normally operative to cut off the fuel supply, but controlled to inoperative position by the flow of oil through the valve, the arrangement being such that when the oil does not flow the motor will be stopped.

VULCANIZER.—E. D. HOSTLER, c/o Hamiel & Mather, Tipton, Iowa. More particularly this invention relates to a mandrel for use in vulcanizing the ends of the inner tubes of automobile tires and the like, an object being to provide a device which permits the tube



A LONGITUDINAL SECTION OF OUTER SURFACES OF THE MANDREL

ends to be vulcanized on the outside thereof, thus permitting a ready manipulation of the tube so as to insure a proper positioning of the parts and also permit of full observation of the vulcanizing process.

NON-SKID FOR WHEELS.—F. HUDA, 469 Division St., Perth Amboy, N. J. The invention has particular reference to means for applying short chains to wheel tires. Among the objects is to provide a simple device for attaching a chain to a wheel felly especially a wooden felly, the chain being adapted to pass transversely over the outside of the tire from one side of the felly to the other, means being provided for the most convenient attachment, and positive holding to the sides of the felly as distinguished from the inner surface thereof.

APPARATUS FOR UTILIZING THE TREPIDATIONS OF VEHICLES.—M. A. CANALE and R. FRIAS, Calle Maiper, 671, Buenos Aires, Argentina. This invention relates to an apparatus for the purpose of utilizing the trepidations and shaking movements originated by the varying of level in any kind of vehicle, transforming them into a rotary motion of sufficient intensity so as to be able to set in motion any kind of apparatus which requires slow speed to work.

Designs

DESIGN FOR A PURSE.—C. A. NICHTHAUSER, 32 Union Sq., New York, N. Y. The inventor has been granted patent on two designs of a similar nature.

DESIGN FOR A RUBBER HEEL PAD FOR BOOTS AND SHOES.—J. E. BARNEY, address Pioneer Products Inc., 30 E. 42nd St., New York, N. Y. The invention has been granted three patents of a similar nature.

DESIGN FOR A TOOTHBRUSH CASING.—E. H. WIERSCHING and E. K. WIERSCHING, 249 Main St., Susquehanna, Pa.

DESIGN FOR A POWDER CONTAINER.—C. S. HUMPHREY, c/o Manhattan Can Co., Bush Terminal No. 10, Brooklyn, N. Y.

DESIGN FOR A SANITARY FOUNTAIN.—T. LLOYD, 1 Taylor St., Boston, Mass.

In the Wake of the Woodsman

(Continued from page 122

abundantly. Experiments with eroded soil prove that much of the soluble salts are washed out. The Department of Agriculture found that in all the constituents excepting potash non-eroded soil was much richer. The greatest difference was in nitrogen, one of the most important of plant foods. This is because a large proportion of the nitrogen compounds are readily soluble in water and were carried off. Not only was the fertility of the soil destroyed but its water-holding capacity was reduced from 67.2 per cent to 46.8 per cent. More water was required to produce a very inferior plant growth on the eroded soil.

Only the very hardiest, and usually the most useless, of plants can gain a foothold on eroded ground and it may be decades after the plants gain a stand before the ground will have sufficiently recovered its fertility through decay of vegetation to support the plants which formerly grew on it abundantly.

When water has finished its destructiveness on barren land, the wind has its innings. Where the eroded area is of wide extent, the wind, unhindered by trees or vegetation, continues in dry weather what the rain has begun, and often six or eight inches of soil will be removed in spots by a single windstorm.

But not only is harm done to the soil. The amount of moisture evaporated into rain clouds is much less where there is no vegetation and a drier climate results. Windstorms are unobstructed and more frequent. This may account, in a measure, for the increasing number of destructive tornadoes in the Middle West in recent years.

One of the principle causes of erosion in the Middle West is over-grazing of cut-off forest lands. Grazing within reasonable limits is not harmful but where sufficient cattle are turned on the land to crop the vegetation close and pack the soil, the future usefulness of the soil is almost sure to be destroyed. A single big rainstorm, under such conditions, may carry away the accumulated vegetable decay of ten years. Once erosion sets in the destruction is sure and rapid, and any known process of rebuilding the soil is slow and uncertain.

The conclusion is obvious; our remedy must be prevention. If care is taken to see that a good stand of seedling trees is left in cut-over forest areas, these only need protection from fire to insure a second crop of timber. Our Forest Service has done wonders with the meager funds as its disposal, but the funds are entirely inadequate. It is estimated that an adequate forest policy would be self-supporting within a very few years. But even if it were a constant expense our lawmakers should be willing to undertake it to insure against a repetition of China's case.

But the problem must be solved not only in the care of our national forests, but in the preservation of our farm woodlands. The farmers own as large an area of woodland as the lumbermen and all others combined. Much of the hardwood supply of the country comes from this source.

The farmer uses most of the product of these lands himself, either as cord wood or for other farm purposes. He usually regards his woodlot as a sort of reserve and when he is in need of ready cash, he cuts off the trees and sells them. As a result few farm woodlands are fully stocked with trees and fewer still have trees which yield the best crop. A campaign of education needs to be undertaken, but such campaigns are expensive and there are no funds available. In this connection it ought to be remembered that not only is the problem one of forests; every single tree whether it be in a city street or a country field plays its part in the regulation of winds, climate

and rainfall. The American Legion has been highly commended by forest experts for its policy of planting trees as memorials to fallen heroes.

The observation of Arbor Day by school children has resulted in the planting of thousands more of trees which will be preserved largely because of their sentimental value.

There is hardly a man but who at some time or other has to make a decision as to whether a tree shall stand or fall. It is the part of patriotism whenever possible to let it stand.

The Last Word in Searchlights

(Continued from page 123)

degrees. It has a grid of five coils mounted in a single plane. Of course, to operate these lamps on land, transformers or resistances are required, depending upon whether the circuit is alternating current or direct current. The 32-volt lamp will operate with no appurtenances on the average boat circuit, which is usually of 32-volts pressure. The globes for all these lamps are of hard glass, lead glass being too soft to withstand the tremendous heat generated.

Beginning this year, sane Fourths of July can take on new glory with the brilliant aid of these incandescent searchlights. Spectacular color effects and beautiful ground and aerial displays have been worked out by engineers for scores of great outdoor night pyrotechnics such as those at the Panama-Pacific Exposition, the Hudson-Fulton celebration and other illuminations nationally famous. Many of these have adaptations which could be used and doubtless will be used in "fireless fireworks" shows of the future based on incandescent searchlights which cost less, operate more economically and are far more adaptable to varying conditions than are searchlights of medium size.

Guiding Ships by Electric Cables

(Continued from page 123)

been put in operation at Portsmouth, one to indicate the entrance channel and the other for the exit channel. The entrance cable starts from a powerful electric station provided with a wireless outfit and runs to a point 1,454 meters to the south, 4 degrees west of Horse Sand Fort, this first part being laid upon a very shallow bottom is not intended to be employed as a guide. The cable then follows the passage southward 63 degrees east for a distance of 10 kilometers, after which it runs 13 kilometers to the south, 1 degree west and 2 kilometers to the south, 6 degrees east. At this point the end of the cable has reached the latitude 53°, 33′, 36″ north, and a longitude of 0°, 56′, 42″ west at a depth of 27 meters. The entire course covers 30 kilometers.

By interrupting the current at given intervals corresponding to dots and dashes of the Morse telegraph code, ships provided with suitable galvanometers or indicators are able to recognize their position as regards the cable at distances of from 400 to 500 meters.

The signal transmitted is the letter V or the letter X, and certain devices enable the ships to signal how far they are from the terminus. Ships which desire to make use of this guide cable, either for maneuvers or to make port, must notify the Block House Fort at least half an hour in advance and must state the time during which they expect to use the cable. Ocean ships communicate by wireless with the Culver Cliff Station which relays the message to the Block House Fort and the latter acknowledges the receipt of it and advises the ship of the time when the alternating currents are sent. The cable is marked 2946 and 2650 on the Admiralty charts. The matter has already attracted interested attention in France, and will doubtless do so in this country. It seems highly probable, too, that the Marine Insurance companies will vigorously push the plan of having ports difficult of access thus safeguarded, since the initial expense is small compared with the loss of even a few boats.

Who Invented It First?

(Continued from page 124)

and received a patent on this same style of clip. Mason immediately filed an application for patent for the same thing, claiming that he was entitled to the patent because he had invented it seven years before and produced the clip and the witnesses to prove that such was the case. The court admitted that he had completed the invention as claimed, but refused to grant him the patent because he had not disclosed his invention to the public, but had concealed and suppressed it. They quoted with approval from a case decided by the Supreme Court of the United States many years ago:

"The inventor, who, designedly and with a view of applying it indefinitely and exclusively for his own profit, withholds his invention from the public, comes not within the policy or objects of the patent system. He does not promote, and if aided in his design would impede, the progress of science and the useful arts; and with a very bad grace could he apply for favor or protection of that society which, if he had not injured, he certainly neither benefited nor intended to benefit. Hence, if during such a concealment an invention similar to or identical with his own should be made and patented or brought into use without a patent the latter could not be inhibited nor restricted upon proof of its identity with a machine previously invented and withheld and concealed by the inventor from the public."

While the great part of the conflicts as to the right to a patent arises between independent inventors, there are cases where the rival claimants do not know of each other's activities. In some of these cases it looks as though there were a deliberate attempt on the part of one party to appropriate the invention of another. Cases of this character are few and are decided according to the same rules as would be the attempt of another to appropriate your watch to his own use. A fact not to be lost sight of is that when anyone makes application for patent he makes oath to the fact that he verily believes himself to be the original and first inventor. False swearing is punishable here as in any other instance of false swearing. Cases which on the surface look like attempts at appropriation, when simmered down often show that such inventor really believes that he and not his rival was the real inventor.

There is another situation wherein the rival claimants for a patent are aware of each other's activities. It arises out of the employment of one individual by another as a result of which the invention is brought to a practicable form or state of perfection by the employee. This can be illustrated best by a decided case. A was the superintendent of a concern manufacturing iron bedsteads. He brought to the foundry of B's company, for the purpose of having a casting made of it, a wooden model of a device for connecting the rail and post of an iron bedstead. He was referred to B as the pattern maker. Some conversation ensued between A and B during which B pointed out some faults, as he considered them, in the model. A went away but returned in half an hour and in the interview then had between himself and B, the latter suggested the introduction of a headed rivet in the model. To this suggestion A acceded, and at the request of B subsequently brought to the latter a section of pipe such as is used in beds, with a headed rivet attached from which B made the model from which the castings were made which were subsequently used in a bedstead. A conceded that the feature of the headed rivet was B's suggestion, although the headed

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rivet was only one element of the invention. The court decided that the invention including the headed rivet belonged to A. The law governing cases of this character was laid down by the Supreme Court as follows:

"Where a person has discovered an improved principle in a machine, manufacture or composition of matter and employs other persons to assist him in carrying out that principle and they in the course of experiments arising from that employment make valuable discoveries ancillary to the plan and preconceived design of the employer such suggested improvements are in general to be regarded as the property of the person who discovered the original improved principle, and may be embodied in his patent as part of his invention."

This rule of law as stated by the Supreme Court is a just one and is based on the general equitable principle that a person cannot be permitted to make capital out of a fiduciary relationship. If the employe had never been taken into the confidence of the employer and entrusted with the underlying principle of the invention obviously he could never have made his improvement. However, if the employe, after the ideas of the employer had been communicated to him devised an independent invention not dependent in principle upon the plan suggested to him by his employer, the employe is entitled to receive the patent therefor.

Our Deep-Sea Freighters

(*Continued from page 126*)

facilitates the handling of either fuel oil or water ballast. The sixth compartment is for the storage of fresh water.

The propelling machinery consists of one Curtis General Electric marine turbine, with double reduction gear, and is capable of developing 3,000 shaft horsepower. When a 17-foot propeller is making 90 turns a minute a speed of 11 knots an hour is realized. The turbine is constructed to operate on steam at a pressure of 200 pounds, with 40 degrees superheat. The turbine rotors can be reversed instantly and are designed to maneuver at half speed—a special valve is provided which admits the steam to either the ahead or the astern rotor. This arrangement provides a desirable degree of operative flexibility. Steam is furnished on each of these boats by three single-ended Scotch marine boilers having a total heating surface of about 8,400 square feet. The boilers are equipped with a forced-draft system, and their oil fuel outfit is of the mechanical burner type. It is said that the double-reduction turbine drive has functioned successfully under severe sea-going conditions.

The ships have numerous winches, conveniently placed, which, with the several 5-ton derricks, are able to handle cargo in a thoroughly expeditious manner. It is a source of satisfaction to know that these freighters have shown themselves to be admirable in many ways and to represent a type which should become conspicuous in our fleet of trade. They are especially suited for the handling of bulk commodities by reason of their distinctive method of construction.

The Isherwood system is primarily designed to afford great longitudinal strength so as to resist the lengthwise stresses set up in a craft exposed to the open seaway. Likewise, the form of structure adopted in this system is intended to promote transverse rigidity so as to offset forces likely to induce diagonal distortion. The ordinary ship is of the so-called transverse-framed type, and lacks in some respects the stiffness which is obtained by the deep frames installed at suitable intervals in craft of the Isherwood pattern. These frames are in effect continuous athwartships because they extend under each deck and rise to the upper limits of the hull.

Analyses of ships of identical dead-

weight cargo capacity but dissimilar so far as the substitution of the Isherwood system is concerned, go to show that the latter method permits of a material saving in weight of steel while insuring a somewhat sturdier structure. It is claimed for the Isherwood-built craft that she is easier to clean and to paint inside—thus promoting better upkeep and lessening the likelihood of unsuspected deterioration. Finally, because of the larger measure of free space in the holds, the advocates of the type say that the Isherwood vessel can carry two per cent more cargo. To put it popularly, we are told that thirteen cargo carriers built on the Isherwood system requires only the same weight of steel as that needed to produce twelve ships of ordinary construction of the same dimensions!

While the Isherwood craft does call for more small fitting work than the transversely-framed boat, still this is discounted by a smaller amount of heating and bending of shapes. In putting an Isherwood steamer together, the erecting can be carried out with greater ease and economy than is commonly the case with the older and generally prevailing practice. And then during the building period the Isherwood ship can be assembled deck by deck—floor by floor as we would say in house building—and this reduces, accordingly, the heights to which materials must be raised while the hull is growing. In the transverse-framed vessel, on the other hand, the frames are erected at the very start to their full height, and everything going aboard for any stage of the work must be lifted up and over the tops of these frames to reach a point within them.

There was a time when we gave little heed to items of this sort, but it must be plain to the thinking person that it takes longer, requires a bigger expenditure of power, and costs just so much more to lift or move any weight a foot in excess of actual requirements. Considering, then, the thousands of pieces of metal and equipment that are brought into place while a ship is still on the blocks, it should be manifest that the Isherwood system reveals how substantial economies can be effected at the very start.

The America's Cup Races

(Continued from page 128)

at any port in which she might find herself for the time being.

The final and decisive race, held July 27th, was won by "Resolute" in a light and variable breeze. "Shamrock IV" led across the line, and Mr. Burton had "Resolute" under her lee. And then followed one of the greatest surprises of these contests; for in the light air of 3 to 5 knots, "Shamrock" succeeded in holding the weather position for over two hours. The start was made at 2h. 17m. and it was not until 4h. and 23m. that "Resolute" succeeded in crossing the challenger's bow. Once clear of "Shamrock," "Resolute' began to draw ahead, and turned the outer mark at 5h. 18m. 35s. "Shamrock following at 5h. 22m. 42s. The "Resolute" gained some 9 minutes on the last leg and finished with an actual lead of 13m. .05s, and a total lead, including time allowance of 19m. 45s.

Thus was concluded the most closely contested series of races ever held on the Sandy Hook course. Sir Thomas Lipton, with the first two races to his credit, came nearer to winning the cup than any of his predecessors. Only once in the past sixty-nine years has the challenger taken a race. That happened in 1871, when the defending yacht, "Columbia," was disabled, and the race went to "Livonia."

Sir Thomas does not take back the Cup, but he does carry with him the warm regards of the American people, and their high appreciation of a sportsmanship which accepts defeat after defeat with a smile and with words of congratulation to the victor.

The Romance of Tungsten

(Continued from page 130)

tungsten was found useful in certain steel alloys. Mixed with an adhesive it was made into lamp filaments that were efficient but exceedingly fragile. However, no metallurgist was able to discover a way to work tungsten separately. This was because in pure metallic form it is absolutely brittle. It confounded all experts with its utter intractability. The established processes in working other metals proved useless with tungsten.

Perhaps it was this very thing which finally brought about the harnessing of this valuable metal. Because it had so steadfastly refused for more than 100 years to respond to the arts of the metallurgist, Dr. Coolidge, with the instinct of the true scientist pioneering in untrodden fields, tried ways that any metallurgist would have thought an idle waste of time. The result was that after long effort and many failures he finally made tungsten ductile and workable so that it could even be drawn like wire down almost to the gossamer fineness of spider's web and still be strong enough to permit its winding and curling into almost any shape. When he had done that he had conquered tungsten and made possible many devices which could never have been built without ductile tungsten.

The radical difference in workability between tungsten and normally ductile metals, the difference which nonplussed the scientific world for more than a century, may be explained thus:

Pure tungsten pressed into bars is brittle after the very treatment which makes other metals most ductile. It differs from all other ductile metals in that when composed of grains it is extremely brittle at "room temperature," but is ductile at this temperature when fibrous.

Many an experimenter had sought to work tungsten mechanically, but none had ever succeeded in getting this intractable metal into a form suitable for mechanical working. Moissan, by an electric furnace method, obtained tungsten in a porous condition which could be slightly compressed and the pores closed up by hammering when hot. However, nobody in the world suspected at that time that if tungsten could be obtained and put into suitable condition and then mechanically worked at suitable temperature, its inherently brittle nature would gradually disappear. But nobody knew how even to make a start upon the problem of working tungsten.

To make any ordinary metal soft it is heated above its annealing point and then cooled down to room temperature. Doing this to tungsten, however, left it as brittle as ever.

Violating all metallurgical rules and working for years with utmost patience, Coolidge discovered the astonishing fact that the only way to make tungsten ductile was to mash tungsten's grains out into fibrosity and thus make the metal ductile cold and this he did by first heating it to a degree below its annealing point and then mechanically working it with infinite pains at a variety of heats each cooler than the one before until the metal got down to room temperature. A similar treatment, if applied to ordinary metals would destroy their ductility.

He worked out a process which, if followed without the slightest deviation, stretched the grains out, thus attaining ductility. But if the working varied from his process, failure resulted. The tungsten would smash to flinders at a stroke when it got cold.

This elaborate and delicately measured system of working tungsten is a scientific triumph.

Thus was tungsten finally made ductile.

The greatest immediate use for it was in the making of electric lamp filaments. Previously the best filament was made of fine tungsten powder, mixed with a binder into plastic mass which was squirted

through fine dies to produce fragile "wire."

This was an enormous improvement over the old-style carbon filament, thanks to the fact that tungsten, with a melting point of 1,350 degree Centigrade, will stand more heat than other metals and its vapor tension is so low that even under tremendous heats its volatile decomposition is slow. Tungsten even in this form made so good a lamp that it saved the American public a billion dollars a year on its electric light bill.

But filaments of those days could not withstand the slightest jar during the process of manufacture. They necessarily could not be strongly mounted in lamps.

Pure tungsten on the other hand drawn into filaments can stand almost anything. For one thing it is one of the heaviest metals. Whereas wrought iron weighs 490 pounds per cubic foot, and lead 708 pounds, tungsten tips the beam at 1,193 pounds. Its tensile strength is startlingly high. After it has been worked down to drawn wire of about a thousandth of an inch diameter its tensile strength is no less than 600,000 pounds per square inch of cross section. This is greater than the best piano wire.

To produce tungsten from sheelite or wolframite the ore is fused with alkali carbonates and the fusion dissolved in water. This may be changed to tungstic oxide by adding acid. The oxide, a yellow precipitate, is then filtered off. The tungsten oxide is purified to any desired degree by dissolving it in ammonia and then precipitating by adding acid, followed by filtering and washing.

To use tungsten in lamp manufacture, it is dried, mixed with thorium nitrate solution and then thinned with water into a batter. This is dried and heated at 2,000 degrees Fahrenheit for an hour in a silica or fire clay crucible to agglomerate the fine particles into coarser ones. This mixture is reduced by hydrogen at 1,800 degrees Fahrenheit into tungsten metal powder.

The reduced tungsten powder is poured into a steel mold which is a slab whose face bears a groove a quarter of an inch wide and deep. Under hydraulic pressure of 16 tons per square inch this groove full of powder is pressed into an ingot 16 by ¼ by ¼ inches. The pressure has been exerted on the sides of this ingot, not the ends. The ingot at this stage is too fragile to handle.

The slug next goes into an electric furnace where it is baked at about 2,400 degrees Fahrenheit. Now it is strong enough to handle. It is then sintered in a hydrogen atmosphere, the bar being heated for 10 to 15 minutes to about 5,000 Fahrenheit by the passage of an electric current through it.

The bar though brittle when cold is ready to be worked. It is heated to about 2,800 degrees Fahrenheit, and passed through the revolving dies of a swaging hammer which reduce its size and produce it in rods growing smaller and smaller and necessarily longer and longer as the metal goes through one swaging after another until it gets down to a diameter of three hundredths of an inch. It is now a metal that is ductile and its strength has increased with leaps and bounds so that at a diameter of three hundredths of an inch it can stand a pull in the proportion of 215,000 pounds per square inch of its diameter.

But it is still too large for lamp filaments, though wound on drums it appears hardly coarser than linen thread. So it starts into the process of being drawn down by successive stages through diamond dies of smaller and smaller sizes to any degree of fineness needed. On the drawing machines it unwinds from the feeding spool, passes through a lubricant, runs through a small gas furnace to attain red heat, negotiates the infinitesimal "eye" in the fragment of diamond clamped in its course, and is wound on a receiving spool ready for use.

Various of these fine sizes of tungsten wire are used for lamps of wide range of powers, the finest of them all being used for the tiniest of lamps such as "bug-lights" on automobiles and in flash lights. The diameter of this is 0.004 of an inch. It is six times finer than human hair. The original pressed ingot 16 inches long would produce more than 250 miles of such wire.

Tungsten wire thus produced is what has made the incandescent lamp the thing of power and service it is today.

The metal is worked in various other ways for its various other uses, but it never could have been had not Dr. Coolidge spent years in experimenting with it beyond the point where the scientists and metallurgists of the world had written the word "impossible."

Gas-Filled Tungsten Lamp Patent Sustained

IN a carefully considered opinion written by Judge Hough, the U. S. Circuit Court of Appeals in New York, sustained on June 2nd, the Langmuir patent No. 1,180,159 for the Gas-Filled Tungsten Lamp. This lamp is the invention of Dr. Irving Langmuir, the well-known scientist in the Research Laboratory of the General Electric Company, which owns the patent.

While several claims of the patent were in suit and sustained by the Court, the commercial nitro-tungsten lamp is well described in the following claim of the Langmuir patent, which is one of the claims held to be infringed by the defendant's lamp:

"An incandescent electric lamp having a filament of tungsten of large effective diameter and a bulb or globe therefor filled with dry nitrogen at a pressure as high or higher than that corresponding to 300 millimeters of mercury, the filament being thereby adapted for operation at a temperature higher than that which it would have if operated in a vacuum at an efficiency of one watt per candle."

The Court recognizes, as did the inventor, that a tungsten filament was not new with Langmuir, and that others, including Edison himself, had previously suggested the idea that a gas such as nitrogen might be introduced into a carbon filament incandescent lamp, but all such attempts to carry out that idea had been complete failures. Such suggestions the Court aptly characterizes as the history of "hopeful suggestion," and points to the fact that in 1913, when the Langmuir invention was made, so eminent an authority as Alexander Siemens regarded the vacuum tungsten lamp as the last word in glow-lamp lighting, without hope of any lamp improvement thereupon which might be of economic importance. The consequence of Edison's failure to find any utility in a gas-filled lamp was that lamp makers, the world over, remained convinced that the better the vacuum the better the lamp. Dr. Langmuir worked out his idea from the scientific standpoint, and the production of the gas-filled tungsten lamp was not only a scientific achievement but a revolutionary idea in practical lamp making.

After reviewing the technical theories advanced from time to time in regard to certain phenomena in incandescent lamps, the Court sums up its conclusions as follows:

"To us it seems fairly certain that both the commercial and the theoretic arts had been put on the wrong road by Mr. Edison through the disclosure of his patent No. 274,295 when in 1883 he proposed to fill a carbon filament bulb with an 'inert gas,' viz. nitrogen, at a pressure of about two-thirds of an atmosphere and stated as one of the means of his hoped for success that 'the filament before carbonization may be reduced to a *smaller* cross section than usual heretofore in order to produce reduction of radiating surface.' This was unquestionably wrong and we fail to find any suggestion in the evidence regarding the scientific discussion and theoretic statement that before Langmuir any scientist disclosed to the world that in the nitrogen filled bulb the loss by convection would be diminished and a working compromise reached between

that loss and the gain in filament life by increasing the 'effective size' of the filament itself.

"The patentee was also the first to establish another crucial and illuminating fact, viz., that with a tungsten filament, nitrogen of ordinary or commercial dryness was worse than useless. There is no evidence that any one before Langmuir had even suggested that in order to prevent a bulb-blackening fatal to the success of any lamp, the removal of water vapor not only from the gaseous filling but from the bulbs and filaments themselves must be carried to an extent theretofore unused, if not undreamed of.

"In short it was not through isolated experiments, but by correlating deductions from many of them, that the patentee produced in 1913 a lamp which, in the larger sizes, can operate on the usual 115-volt circuit with an efficiency as low as a half a watt per candle. . . . Not even the laboratory problem had been solved before this patentee did it; and we hold with the lower Court that invention was present."

While thus sustaining the patent on certain claims and against a specific construction found to infringe, the Court points out that the patent may possibly hereafter be construed to cover filaments other than tungsten and gaseous fillings not named in the specification of the patent.

Right Foundation for Our Roads

THE United States Bureau of Public Roads and the Federal Highway Council are jointly conducting a national inquiry to obtain scientific information concerning the characteristics of road-building soils. The coöperation of thirteen highway district engineers has been obtained, 20 sample bags and tag envelopes having been supplied each engineer for shipping samples of highway soil to Washington.

Road failures attributable to unstable foundations are possible of elimination by pursuing either of three alternatives: By having the road surface thick enough so that the pressure will be sufficiently distributed to the underlying subgrade or so that the surface due to inertia may absorb much of the shock of traffic; by designing the slab so as to insure adequate strength over the soft subgrade; or by improving the drainage systems to exclude the moisture in dangerous quantities from soils having very low bearing value due to the presence of water.

The nation-wide research as to the specific reasons for failures of highways involves the inspection of "break-downs" due to inferior subgrades, whether attributable to inadequate drainage or to peculiar soil conditions. Samples of one cubic foot each are taken from the subgrade, photographs made describing the failure, and exacting information furnished relating to topography, preferably in the form of cross-sections and profile of the road in the vicinity of the undermining influence. Notes are to be written describing the character of the failure, the approximate amount of traffic, drainage conditions, the presence of water-bearing strata or other influences that may be responsible for the wet condition of the subgrade.

An auger 1½ inches in diameter is suggested by the Bureau of Public Roads as a convenient instrument for exploring the underlying subgrade, useful information being obtainable by observing the texture and condition of moisture of the soil at varying depths. How the water reached the subgrade—whether by vertical or horizontal capillarity, through seepage strata, from the surface, etc.—is to be emphasized as essential data. If the soil at the surface is wet, very compact, dense and dry below, the chances are that the water penetrated the subgrade from the surface and was forestalled from release by the underlying impervious layer. If the underlying layer of a wet subgrade is moist and porous, and it in turn is underlain with compact pervious clay which is dry, the suggestion occurs that the porous layer is a seepage stratum through which water is flowing and is rising to the top of the subgrade by vertical capillarity.

"It is perhaps true that all soils have adequate bearing value when the amount of water in them is kept to a sufficiently low percentage," says the Bureau of Public Roads, "or it may be possible that certain soils will be susceptible of treatment which will render them of higher bearing value than they have in their natural state.

"It is obvious that if we are to advance our ideas regarding road construction we must begin with the road foundation and must gain accurate information as to what properties of soils make them good or poor soils for foundation purposes. With this knowledge in hand, we will then be in a better position to say how the road should be designed when it is to be laid on these particular soils, or possibly how we should treat the soil when its characteristics are known in order to increase its bearing value."

New Metal Alloy

DURING the war an Italian engineer, Adolfo Pouchain, after a series of experiments succeeded in producing a new alloy of zinc and copper, which has been given the name "Biakmetal." This alloy quickly demonstrated its usefulness in Italian industry, and by reason of its special qualities promises to attain similar success throughout the world. Biakmetal has aroused considerable interest in Italy, and we are told by one of the large manufacturers that his metallurgists have made every effort to determine its exact composition, but without success.

From a small beginning the demand for Biakmetal has increased to such an extent that a new company has been formed to carry on its manufacture. The industrial value of a product which is stronger than steel and less corrosive than copper is evident, and it is claimed that Biakmetal, which has passed the experimental stage, possesses these qualities. The most important characteristics are stated to be as follows: (1) The highest known breaking point; (2) the highest limit of elasticity; (3) perfect homogeneity; (4) high resistance to thermic action; and (5) high resistance to chemical action.

In the matter of strength, comparisons have been made between different grades of Biakmetal and copper, brass, and cannon bronze, which showed interesting results. Among these, tests were made of rods of various kinds of metal to determine the weight and size required to give a tensile strength of 500 kilos. The results of these tests were as follows (figures in parentheses represent the diameter of the rods tested, in millimeters, and the other figures, the weight of the rods in kilos per linear meter): Copper (12.6), 1.126; brass (9.5), 0.616; cannon bronze (10.3), 0.723; Biakmetal, No. 3 (6.3), 0.271; Biakmetal No. 6 (8.4), 0.178. (Millimeter, 0.0937 inch; meter, 39.37 inches; and kilo, 2.2046 pounds.)

These figures indicate a surprising superiority on the part of Biakmetal. Where Biakmetal No. 3 is used the same strength is obtained with a diameter and a weight considerably less than those of rods of other metals, while with rods of Biakmetal No. 6, of a diameter less than other metallic rods, the weight may be reduced to a small fraction of that of rods of other metals.

Biakmetal is extremely well adapted for almost any kind of manipulation. It can be successfully cast, turned, drawn, forged, rolled, and stamped. While its development is still in progress, it has already proved especially useful in aeronautic and marine construction on account of its light weight, its unusual strength, and its anticorrosive qualities. In its different forms it may be substituted for steel, brass, and aluminum, and for certain uses has important advantages over these metals.

Notes and Queries.

Kindly keep your queries on separate sheets of paper when corresponding about such matters as patents, subscriptions, books, etc. This will greatly facilitate answering your questions, as in many cases they have to be referred to experts. The full name and address should be given on every sheet. No attention will be paid to unsigned queries. Full hints to Correspondents are printed from time to time and will be mailed on request. Please write your queries; do not telephone them, please.

(14337) The correspondent from 83 Cottage St., Lynn, Mass., is informed that his queries will be answered if he will repeat them signing his name to the letter. We do not answer anonymous letters.

(14338) A. M. asks: Can static electricity be changed to current electricity of low voltage, and how is it done? A. Whenever an electric spark passes across a gap static electricity is transformed into a current of electricity. But if you mean to transform such a discharge into a low voltage current for purposes such as are served by a battery, we should answer in general that such a transformation cannot be made.

(14339) O. C. S. asks: Can you suggest a simple method of testing ink for acid? A. The simplest way to test ink for acid would seem to be to drop into the ink some carbonate of soda (washing soda). Cooking soda (bicarbonate of soda) will answer the same purpose. If the ink is acid it will foam from the carbonic acid which is formed by the action of the acid upon the sodium salt. Probably also blue litmus paper may be used. The black of the ink would hardly stain the paper so much that the red from the acid could not be seen. An acid turns blue litmus red.

(14340) Chas. E. S. asks: I take the liberty of addressing you to ascertain if you know of any process by which the salt can be removed from salt water other than by steaming and condensing so that the water can be used free of salt at low cost. A. We know no way of removing the various salts from sea water in order to obtain fresh water for use, excepting by distilling the water. There are several chemical salts in sea water besides the common salt, which the chemist calls sodium chloride. All of these would not be removed by the same chemical process which would remove the common salt, while distillation will remove only the fresh water leaving all the salts behind.

(14341) F. H. R. says: I claim that anything which will sink in a tub of water will sink to the bottom of the ocean, vessels included. My friend argues that a vessel will sink to a depth of about 4,000 feet and there remain floating between the surface and the bottom. Will you please inform us who is right? Have you any publications for sale which covers this subject? A. Your inquiry has come to us very many times since the sinking of the Titanic and we have several times published the answer. The fiendish work of the submarine revived interest in the subject and now we have recently had a number of inquiries about the matter. Hence we will print the discussion of the topic again. Anything sinks in water when it weighs more than the same volume of water weighs. A cubic foot of fresh water weighs 62.4 lbs. Anything which weighs more than this per cubic foot will sink in fresh water. The density of sea water differs somewhat in different oceans and seas. It may be taken at about 1.03. At this figure a cubic foot of sea water would weigh about 64.27 lbs. Anything heavier than that per cubic foot will sink in sea water. Another most important factor is that water like all liquids is nearly incompressible. So incompressible is it that at the bottom of the deepest ocean, six miles below the surface the water is only 20 per cent heavier than at the surface, and a cubic foot of sea water at the bottom only weighs 77.12 lbs. Anything which weighs more than that per cubic foot will sink to the very bottom of the ocean in its deepest known place. Aluminum, the light metal, weighs 166.5 lbs. per cu. ft.; iron weighs 450 to 480 lbs. per cu. ft.; and stone weighs from 135 to 200 lbs. per cu. ft. Of course they go to the bottom anywhere when placed in water. There is a widespread impression that the tremendous pressure deep in the ocean will prevent sinking. Pressure has nothing to do with the case.

The pressure of the air upon us is tremendous, more than a ton on every sq. ft., yet we fall swiftly through it simply because that pressure is the same on all sides of us, up, down and sideways. The same is true of water pressure. At any point the pressure is equal in all directions and does not retard sinking. An iron ship when filled with water goes swiftly to the bottom, as does anything which weighs more than the same volume of water. We do not know any book which treats the matter specifically. It is an application of the simple law of floating, Archimedes Principle, it is called in Physics.

NEW BOOKS, ETC.

THE PETROLEUM HANDBOOK. By S. O. Andros, A.B., B.Sc., E.M. Chicago: Shaw Publishing Company. 12mo.; 206 pp.; 48 illustrations; 17 tables.

The many phases of the oil industry are all brought together here, and the fundamentals so concisely presented that the Handbook will appeal to producers, refiners, marketers, jobbers, salesmen, investigators, geologists, engineers and students. It describes all operations from the location of a well to the distribution of the refined products to the consumer, embodies pertinent facts culled from government bulletins and state reports, and forms a most satisfactory nucleus about which to build a library of more specialized works.

APPLIED OPTICS. The Computation of Optical Systems. 2 volumes. Translated and edited by James Weir French, B.Sc. London: Blackie and Son, Ltd., 1918. 8vo.; 377 pp.; illustrated.

The enhanced interest in optical glass in this country, due directly to the lessons of the war, makes a translation of the *Handbuch der Angewandten Optik* of Drs. Steinheil and Voit a valuable addition to the literature of the industry. Indeed, we believe this is the only published work giving a complete and thoroughly practical trigonometrical system of optical computation. The first volume deals with the principles of optics and the derivation of necessary formulae, the determination of simple lens forms, and the calculation of aberrations and combinations. The second volume includes the determination of refractive indexes and dispersions, the computation of achromatic prisms and of doublet objectives, and a dicussion of aberrations of different combinations.

FIRE DEPARTMENT MOTOR APPARATUS INSTRUCTION. By Capt. Daniel A. Sullivan. New York: Civil Service Chronicle. 8vo.; 95 pp.; illustrated.

There are thirty types of motor apparatus in use by the New York Fire Department: Capt. Sullivan, long instructor in the Department's automobile school, describes each type in "firemanic language," with lavish illustrations. Other chapters make clear gas engine parts and principles, the equipment of trucks and hose wagons, tools, lubrication and lubricating systems, ignition, and the theory of the dynamo. It is a complete and readily understandable text that will prove of the greatest service to students of fire department apparatus.

A TEXT-BOOK OF PHYSIOLOGY FOR MEDICAL STUDENTS AND PHYSICIANS. By William H. Howell, Ph.D., M.D., Sc.D. Philadelphia and London: W. B. Saunders Company, 1918. 8vo.; 1059 pp.; illustrated.

This standard work comes to us in a new edition that takes full account of the expansion of physiological and medical research in the past four years. In sifting the evidence for and against new theories, the author's stand is honest and impartial, and time and again he demonstrates his good judgment in stressing only what experiment and experience have sanctioned. In wending his way through the many difficulties that beset any presentation intended for the student rather than the specialist, he has made the path clear for the reader. Accepted fundamentals are vitalized by the new thought-current; the result, in Dr. Howell's skillful hands, is a text of the highest merit.

A HANDBOOK OF AMERICAN PRIVATE SCHOOLS. Boston: Porter E. Sargent, 1919. 8vo.; 761 pp.; illustrated.

The 1920 edition of this annual survey more than sustains its reputation for carefully-gleaned, comprehensive information such as the parent must have before he can choose wisely his child's educational environment. The work is more and more exceeding its original scope. Besides its critically descriptive lists of boys' and girls' schools and summer camps, which include art and trade schools and the private institutions of Canada, with location maps, we find much material of distinct service to school and college executives. There are sketches of history and progress, discussions of educational reconstruction, and a survey of the educational literature of the year past. Beginning with this edition, the handbook now covers not the calendar, but the academic year.

MANUAL OF SUGGESTIONS FOR TEACHERS. By Benjamin C. Gruenberg. Boston and New York: Ginn and Company, 1919. 12mo.; 95 pp., illustrated.

The teacher who uses the author's "Elementary Biology" will find these suggestions extremely useful in organizing material and ideas, and in the effective presentation of the subject to their classes. It's interpretations, applications and references form a valuable supplement to the original text and to such material as the Department of Agriculture, the Public Health Service and the Bureau of Education issue from time to time.

THE PROTECTION OF METALS FROM OXIDATION AT HIGH TEMPERATURES. By W. E. Ruder. Vol. I. Detroit: Calorizing Corporation of America. 8vo.; 40 pp.; illustrated.

Protective coating processes and the development and application of calorizing are here set forth in brief but exceedingly helpful paragraphs. Leading manufacturers report their experiences with gas-making retorts, tubes and pipe, and the dependable tables offered may be advantageously used in various calculations and operations.

SELECTED ARTICLES ON PROBLEMS OF LABOR. Compiled and edited by Daniel Bloomfield. New York: The H. W. Wilson Company, 1920. 8vo.; 436 pp.

To the investigator of industrial movements and problems, this summary offers a quick way of familiarizing himself with outstanding features of the terrain, and its lengthy bibliography points the road to more thorough exploration. The work brings together in orderly from discussions of friction and unrest, methods of compensation, hours, tenure of employment, trade unionism, disputes and adjustment, limitation of output, industrial insurance, occupational hygiene, and women in industry. Varying points of view are presented, and the trend of the work is constructive.

SELECTED ARTICLES ON THE AMERICAN MERCHANT MARINE. Compiled by Edith M. Phelps. New York: The H. M. Wilson Company, 1920. 8vo.; 344 pp.

This work was first published in 1915 to arouse the interest and answer the questions of those who were following the fortunes of the bills providing for Government participation in the ownership and control of our merchant marine. This second edition adds much material setting forth the situation developed since the creation of the Shipping Board, and takes up the disposal of the fleet. From historical facts to present conditions, the student will find all important questions debated from various points of view by well-qualified disputants. The arguments are preceded by briefs, and there is a good bibliography.

KEY TO THE BIBLE AND HEAVEN. By Ludwig B. Larsen. Portland, Oregon: Ludwig B. Larsen. 8vo.; 280 pp.; illustrated.

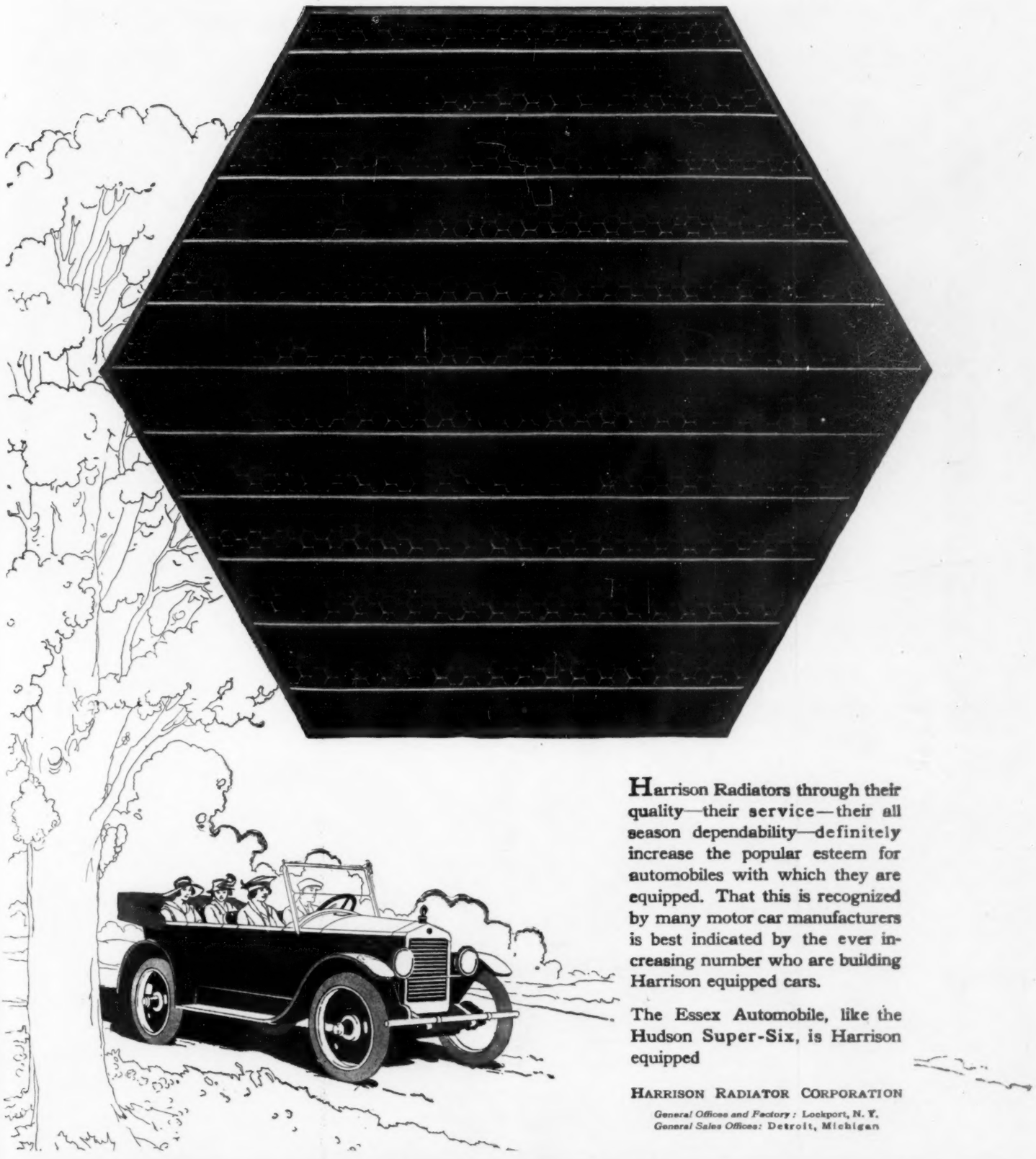
The writer regards the Bible as a treasury of astronomical, astrological, and geographical information, and interprets its symbolism in accordance with this belief.

"PRACTICAL ENGINEER" MECHANICAL POCKET BOOK AND DIARY. 1920. London: The Technical Publishing Co., Ltd. 800 pp.; illustrated.

For thirty-two years this British pocket book has catered to the needs of the profession. Data of steam, gas, and oil engines, air compressors, heating and ventilation, hydraulics, etc., are supplied in concise form; in material new to this issue we find information on boiler chimneys, steel stacks, chains and pyrometers. The Buyers' Guide, in French, Spanish and Russian, continues to be a prominent feature.

INTERNAL-COMBUSTION ENGINES. By Wallace L. Lind, Lieutenant Commander, U. S. N. New York: Ginn and Company, 1920. 8vo.; 225 pp.; illustrated.

Lieutenant Commander Lind's text is crisp and business-like in its phrasing, and will be found well-adapted to the average student. One chapter, addressed to readers familiar with thermodynamics, presents the theory of the various cycles. Besides the usual considerations of fuels, combustion, carburetion, etc., there are discussions of the regulation of speed and power, the measurement of power, and the principal engine parts and their functions. Aircraft, marine, and automobile types are described, with the cause effect and remedy of troubles.



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